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OBITUARY.—MR. GEORGE TREADWAY THOMPSON.

Last week we were obliged to report the death of Mr. George Treadway Thompson, whose term of life came to a close at a late hour of the night of October 1st. Our brief mention of last week regarding this sad event was in error, in that the death date was named as the evening of October 2d. The end of his earthly time was in Denver, Colorado, and at his couch was his mother, whose beautiful example of maternal devotion during many trying months it is not unseemly to mention here, for it was known to and remarked upon publicly by many of the gas fraternity who had at times, while passing through Colorado, stopped over in Denver to have a word with the patient, gentle sufferer, that they had known in his activity as a bundle of nerves and an example of forcefulness.

The following history of his life may be accepted as fairly accurate, and a look over the record thus given will show that in his 31 years he had encompassed much. George Treadway Thompson, who was the son of James Dulty and Georgia Treadway Thompson, was born in St. Louis, Mo., September 3d, 1869, to which city his father had removed in 1875, from New York, to assume the duties of Secretary and Treasurer of the Laclede Gas Light Company. That Company was largely formed through the efforts of Mr. Thompson, senior, who had enlisted in its behalf the aid that came with the backing of the then well-known New York City financial house of Soutter & Co. The first, in fact the constructing engineer of the Company, was Mr. William Farmer, between whom and Mr. Thompson, senior, much cordiality of feeling existed, which bit of history goes to show that the subject of this memoir traces back in his affiliations with the gas industry to men whose names will always be connected with its best development.

Deceased acquired his earlier tuition in the public schools of St. Louis, and finished his educational training in the Washington University of that city. Graduating therefrom, in the Class of 1886, he at once entered the employment of the Laclede Gas Light Company, and his first practical tutor in the art of gas making was Mr. Frederic Egner, then the Chief Engineer of the corporation, who we believe succeeded Mr. Farmer when the latter had completed the construction of the works—if memory serves aright that was accomplished in 1876.

Alert, capable and retentive, young Thompson's progress in the practical ways of gas making and distribution was rapid. From apprentice to supervisor took up a period of perhaps four years, for, in January, 1890, he was given charge of the Company's distribution division, and his work in that department was so satisfactory that in a comparatively short period he was appointed Superintendent of its works, known as "Station B." About 1890 (in fact, to be precise the amalgamation may be put down as occurring in 1889–90), the Laclede Company succeeded to the properties and rights of the old St. Louis Gas Light Company. His administration of the affairs of Station B was sufficiently successful to attract the attention of Mr. Emerson McMillin—it was through the prime ministering of the latter mainly that the amalgamation of the "gas interests" of St. Louis was eventually perfected—then and now President of the Laclede Company.

The McMillin syndicate had gone on acquiring gas properties in one way or another in different places, and the need of a directing engineer or supervisor for all of them was pressing. The choice for this supervision came to Mr. Thompson, and in 1896 his headquarters were established in New York. This added responsibility seemed to weigh lightly upon him, although its manifold and perplexing details were not at all a light burden.

Never of a robu t physique, and with a temperament that fairly sparkled of energy, a slight cold soon grew into a severe disorder, and July, 1898, found him virtually exiled by the decree of his physicians. Towards the close of that summer he went to St. Paul, Minn., and later on to San Antonio, Texas, as the personal representative of the President of the gas companies of the named places. In March, 1899, he went to Denver, and in the following June he was elected President and Treasurer of the Denver Gas and Electric Company, which corporation resulted from the merging of the Denver Consolidated Gas Company with the Denver Consolidated Electric Company. There his earthly activity ended, and of him it may be truthfully said that no trust ever committed to his care was slighted.

Apart from and outside of his strictly professional career, deceased was best known to the gas fraternity at large through his active connection with the Associations that have done so much towards fostering and developing the business. His best allegiance to any of these was towards the Western Gas Association. Becoming an active member thereof at the 1888 meeting, he served it so well that his fellows promoted him to its "Wrinkle Editorship" in 1893, and continued him so until 1897. He served on its Board of Directors for three terms, and, in 1897, he was chosen Second Vice-President. In due time he became President of the Association, but in the year of his Presidency (1899) ill health prevented him from directing the affairs of its 22d annual meeting, held at Milwaukee. His pluck and his desire for its advancement were such, however, that he prepared a presidential address, the tone of which showed how earnest he was for the Association's welfare. Ever active on its behalf, he was a frequent contributor of papers to its programme, a hard and enthusiastic worker on its committees, whether those were of a technical or a social sort. He joined the American Gas Light Association at its 1891 meeting, and served it faithfully and well—he was a member of its Council for the term from 1895 to 1897. He was an active member of the Ohio Gas Light Association, was elected to active membership in the New England Association of Gas Engineers, at its 28th meeting (1898), and joined the Society of Gas Lighting at the annual meeting for 1898. During his residence in New York city he was on the rolls of the Engineers' Club and of the Lotos Club. In the space of this article it is impossible to properly elaborate or even enumerate the good work from a professional standpoint that deceased accomplished. But it may properly be said that he was a painstaking student, a thoughtful and successful practitioner, and an honorable gentleman, and that in his three tens of years he accomplished much that will place his memory on a plane with many of those whose span was counted in equal scores.

The funeral was held in St. Louis, Mo., October 5th, from the resi dence of his brother-in law, Mr. E. R. Hoyt. In the wealth of floral offerings that embowered the casket which held his remains were two handsome tokens—one from the Western Gas Association, the other from the American Gas Light Assoeiation. In his death the gas profession has lost one whose best thought, aim and effort were for its advancement, and whose success in his chosen line was far beyond the measure of his years.

NOTES.—The State Board of Gas and Electric Light Commissioners, as a result of the hearing on the petition of certain residents of Fitchburg, Mass., for lower selling rates in respect of the gas and electric lighting services of the Fitchburg Gas and Electric Light Company, has recommended that the net gas rate be fixed at $1.45 per 1,000 cubic feet, a reduction of 15 cents. In the instance of the electric light service the rate for arcs on commercial account is put at $6 per lamp per month, a reduction of $1; and it is recommended that the arcs maintained on public lighting account be supplied at $100 instead of $110 per annum each.——The Bergen County (N.J.) Gas and Electric Company proposes to extend its mains to the village of Englewood Cliffs.——Mr. J. S. Dickson has been appointed Manager of the Mattoon (Ills.) Gas Light and Coke Company, vice Mr. W. E. Bellmer, resigned.——At a recent meeting of the Everett (Wash.) City Council, Mr. C. R. Collins, of the Seattle (Wash.) Gas and Electric Company, presented a petition for a gas franchise. His associate in the enterprise is Mr. C. B. Hurley, of Tacoma.

[Prepared for the JOURNAL.]

The Illumination Problem Again.

By DR. W. H. BIRCHMORE.

How comes it that an educated man, and a member of the American Gas Light Association, fails to discriminate between space and a surface? This question troubles me, for it shows that the reason we cannot advance at all in our attempts at improving illumination is because the men who are in position to experiment in the matter muddle the problem. They fail to discriminate, and this failure becomes distressing when the confusion thus produced is mistaken for order, and as such is made a matter of record. The questions involved in arranging a series of radiants in position to illuminate a finite surface constitute a very different problem from that involved in illuminating a finite space. The fact that space becomes to us a sensible thing only when it ceases to be space is almost invariably lost sight of in the war of words waged to confusion of the details surrounding the central proposition. The sun sends just as many waves of light through all the rest of space as through the infinitely trifling part of it occupied by the moon. All space is equally illuminated at the same distance from the sun, and we are conscious of the moon only because it interrupts and, therefore, limits space. At the same time we see the moon not as space but as a surface. In other words, the light we use, or is of use, to convey an idea to our brains, assuming an idea can be so conveyed, is not light which is illuminating space. This function is in abeyance, and it is owing to this fact that we see. When we illuminate space by artificial means we fill it full of force vibrations. We strive to have as near as may be the same number everywhere, or at least to have them in force in that part of space which will be most useful to us, in order that they may be interfered with by surfaces and thus be made useful. The man who manipulates a searchlight illuminates space in a way. If there were nothing in the space we would not see the beam which we do see illuminating the vapor of water, and when the beam falls on the sails of a ship he is no longer illuminating space but a surface, as it was intended he should; and the same is true when one tries to read a newspaper by a street lamp or a penny dip. In other words, the only light which is useful to us is light which illuminates not space but surfaces. This distinction should be held in mind.

Some time ago (JOURNAL, Nov. 29 and Dec. 13, 1897) I considered a special case describing the special arrangement of a set of lights in reference to a definite problem. In the JOURNAL[1] for October 23, 1899, p. 650, is another study of a special case containing, in addition to the study, which seems to have been sufficiently done, some references to other parts of the problem, so couched as to seem almost direct challenges to criticism.

In the first place, there is not the smallest relation between the title and the matter in the paper, which is not a view, or study, or anything else of the illumination of interiors nor of interior illumination, but which is a careful study of the illumination of a special exterior; to wit, the surface of the printed page of an open book. It is not even a case of form image in space; it is simply a case of form (contrast) image in plane. The problem is one of contrast-image and of that alone. This direct contradiction is disconcerting to the mind of the reader. I have read this paper faithfully four times, with pencil at hand, and after this careful study I am decidedly of the opinion that, if all which goes before the sentence, "For some years his eyes had been giving him much trouble," be considered as the observance of a traditional literary form, as an introduction to that which comes after the above mentioned clause, the essay divides into a jejune discussion of important questions which have nothing to do with the case, and a full, sufficient, satisfying and most praiseworthy study of a special case from a special standpoint; a study so well made that it tempts the reader to regard it as good enough to form an item in the basis of the general solution.

Taken as a whole the paper is capable of doing much harm. Its very first sentence contains an implied generalization; he seeks a "good light for the eyes." He wishes us to understand that he has found one, but his treasure trove when closely examined proves to be only the least disagreeable among many disagreeable to a given pair of eyes. In a word, this very first sentence postulates, by implication, a fallacy. It assumes that the quality of goodness, or of suitability, is inherent in the light as an active quality; while, in point of fact, this "goodness" of the light is simply an expression of the fact that takes pleasure in it; likes to use it in fact. No doubt Mr. Morton is perfectly honest in his misconception.

I would not for a moment insinuate that he did not think the quality

1. "Another View of Interior Illumination," by Mr. F. N. Morton, Hoboken, N. J.

of goodness or badness was an attribute of the light—that is his fundamental error. The personal element is the important one, and while we may be as firmly fastened to the procrustean bed as Mr. Morton is, we students of the bed certainly intend that all the world shall know that the bed was made by art, commercial at that, and not by nature. This desire, for some unmentioned reason, Mr. Morton does not share.

Curiously enough, Mr. Morton, in the second paragraph, sets forth a theory which is to say the least a peculiar one, unless indeed a part of the sentence is omitted, which is grammatically possible. The fact is that the usefulness of an illuminating unit is a function of its intensity, and increases with it, until the superficial reflection of the illuminated surface causes an obliteration of details which find their existence evidence in simple absorption contrast. This is shown every day by the experience of mankind, and it is almost comic to see the dim and insignificant lights of lamps and candles preferred for reading by people whose rooms are brilliantly lighted by electricity. It is this fact, the influence of reflection on visibility by surface contrasts, which Mr. Morton has to reckon with. Like a broken lath in a bundle it is a nuisance, and the fact of its existence limits his solution narrowly, practically to the case in discussion.

But in addition to this misconception of the fundamental problem is an odd disdain for important facts. While sharing with him the doubts which he expresseas as to the importance of shadow I am amazed that he should compare the conditions given by Dr. Standish with those of his experiment with the drawing board. The differences are obvious enough, and had he considered for one moment it is probable that the statement of this experiment with the drawing board would not have been mentioned.

His reference to my work, and the comparison of that brilliantly lighted room, with its hard, smooth, white walls, to the gloomy ferry house is certainly suggestive; and the statement that "somewhere in the angle of vision would appear a number of naked lights reinforced by reflectors, with correspondingly dazzling effects" is very queer, for I took particular pains to show that the reflectors were seen as illuminated, not by the lamps, as Mr. Morton's words suggest, but by the floor reflection, so that the reflectors appeared less brilliant than the wall and gave no glare unless one lay on his back on the floor, and the diffused light was sufficient to neutralize the contrast between the "naked lights" and the white wall above the cornice. In fact it is obvious that Mr. Morton did not read my description. He only "glanced at it," and did not think as much of my work as I did of his, enough to study it, at least so it would seem. But these two misstatements or misconceptions, are trivial compared to the utter misunderstanding in reference to "vacuum light" and the arc. In reference to the arc light, why did Mr. Morton not say, simply and distinctly, the arc light is unsuitable for illuminating surfaces when the intention is to read or write. There is no mystery about it. There is nothing more to be said. All the men with experience know that in a *white room* the arc light is unsuitable, but it is not worth while to enter on the discussion, as in the study of all such questions it is needful either to exhaust it or to let it alone, and with the reprint of all that has yet been written the subject would be only entered upon.

The remarks in reference to McFarland Moore's experiments show the same inadequate study. Moore's radiant tubes and the Crookes' tubes had nothing in common but the exhaustion. Neither the character of the luminosity nor the amount is strictly comparable between the two, and surely the view is strangely superficial which regards the electrical stress in the one as equivalent to the transfer in the other. Repeated experiments have shown the total dissimilarity, and the Moore tubes can and have been shattered in fragments by making the electrical stress too great.

If people intending to write about such abstruse matter would get the data first many errors and misconceptions might be avoided. Even Mr. Moore himself had but the faintest idea of the facts in relation to these most marvellous tubes. Mr. Morton mentions the inconvenience to his wife's eyes. This was a common complaint, and the most interesting part of the problem is the fact that the rays causing the distress which Mrs. Morton experienced, as did many others who exposed their eyes to injury, were the expression of the stress on the surrounding atmosphere and had an origin demonstrably outside the tubes. These rays it was found made no fair image to the eye, and the location of origin and place in the spectrum were discovered only by the inspection of photographs.

It is to be hoped that at some future time this experiment of Mr. Moore's will be adequately studied. The whole matter, both its theory and practice, needs investigation. Moore was like a child on the sea beach; he picked up a pretty shell, he showed it to us, some of us recognized it as important, no one of us has had time or opportunity to study it adequately. May the future bring the man and the opportunity.

Turning from this most unfortunate introduction to the narrative of the experiment proper we find material for most remunerative study. One cannot but wish Mr. Morton's method had been more exact, for he had a chance to get some very useful data. Maybe his opportunity still exists. Unfortunately the paper contains no data. Mr. Morton says, "My first plan was that of tinting (the light) by translucent globes of various colors. Yellow, red, pink, blue and green were tried, but without success. The yellow, instead of tempering the extremely white light of the burners to a pleasant color, something like that of an open flame, as was expected, cast an unpleasant yellow glare over the room. The other lights were simply varying in the trying effect on the eyes, the light green being the least unpleasant."

This sentence covers so much ground that it is almost a text for a discussion of the general theory of illumination. Unfortunately, however, the scientific value is abridged by the lack of data. Why did not Mr. Morton call in some young man from Stevens to his aid? He had immortality in his hand, and he has, perhaps, let it slip. Mr. Morton goes on to tell of his paper screens. This brings his experiments into tangible ground, and he found green his color of choice. *This is the third recorded case in which green has been the restful color.* Surely this is no matter of chance. Have we a condition of the retina in which this "means something," as the enjoyment of certain tones gives rest to people who have an abnormally sensitive sense of hearing. This question becomes of the highest importance in relation to eye-tire, as is readily seen if one is reminded that green is an alleged primary sensation. It looks indeed as if Mr. Morton had come within reach of an important series of facts, for while everyone knows that the so called "three color lantern" can be made to work with almost any set of colors, provided the same colors are used both for taking the negatives and for projection, almost no one has attempted the same in reference to the ocular image. Mr. Morton very exactly states his own experiences in matching the worsteds, but if I understand his account he does not state his patient's experience.

If we study the mantle lights, both quantitatively and qualitatively, by prismatic analysis, using photography for the record, we find that the intensity of the illumination is a function of the age of the mantle in all parts of the spectrum. It is also a matter of the first consequence that not all eyes see the colors of the spectrum alike; that is, translate the physical contact into the same sensation.

In studies of this character many kinds of screens have been used, colored paper, colored glass, and fluids, which latter are in fact solutions of various materials. Classifying such experiments and repeating for record much valuable data can be reached, but vastly more must be collected before one can get enough to exhaustively investigate. The use of paper screens by amateur photographers has given an immense amount of data. The Eastman Company furnishes a paper which, within limits, is practically safe. The Denison Company furnishes a red and a yellow, colors seemingly so well known to their salesmen that if you tell them you want it for a dark room they give you two sheets of a slightly yellow red and one sheet of a slightly reddish yellow. These will exclude the actinic rays of a "North Light" so completely that I have left Cramer plates "Lightning Crown" exposed for an hour without producing the slightest cloud; but this combination does not quite protect against sunlight and often fails against the arc, more often than not, in fact, usually. Why it does not fail always I have yet to learn. But such screens wonderfully darken the room; they diminish the luminosity wonderfully.

Extending this question to single sheets of paper, Denison tissue stretched on frames, one soon finds that while the whole spectrum is impeded, it is nowhere absolutely stopped, but usually the complementary tint is suppressed, partially. Of course a spectro-photometer must be used to measure it. One cannot avoid noticing one failure in theory, the color transmitted and reflected seems to be the same. They should be complementary. That which transmits red for example should reflect blue and green, the surface color being the complement of the one transmitted tint. If the paper is carefully soaked in some very refractile fluid, as glycerine or cocoanut oil, the paper sometimes becomes transparent without the loss of its selective power, in which case it not infrequently shows, in feeble degree, the said complementary tint. It would be interesting if Mr. Morton would extend his study of his special papers in this direction. Most important data might be gathered; important both in theory and in practice, in science and in art.

While collecting data, on superficial reflection I found that the two

sets of observations simply would not agree, and I was forced to abandon the method of direct illumination and adopt the system of ray filters, rendering the light more or less accurately mono chromatic by excluding the undesired pencil. This was accomplished in a very simple way. The ordinary Welsbach fixture was placed in a light, tight, but well ventilated box, from which projected a tube. On the end was placed an achromatic objective, throwing an image of the mantle on a screen of "Whatman-Not." A variety of calculations and corrections are required, which need not be given here, to determine the amount of illumination, but the illuminated surface was just 100 square inches. The screen was perfectly normal to the axis of the beam. Into the path a "ray filter" was adjusted. Of these filters I had a number holding from one to four colors, so that I could try many experiments. I also had slits and prismatic apparatus by means of which various spectra could be obtained and superposed. A very various collection of anilines was studied. After a certain amount of data had been collected my co-worker suggested that we try some experiments on "utility." To do this we arranged a mirror of polished speculum metal to throw the light on the printed page.

The experiments consisted in throwing the tinted light on the page in an otherwise dark room and examining the subjective result. A large mass of data was collected. The most trifling part of this has been discussed and none exhaustively, but we found out a number of startling facts.

We experimented, first and last, on 23 people with the widest range of intelligence. The extremes were two professors of physics and the man who cleaned the rooms, "the scout." People with "good eyes" and "bad eyes," myopes, astigmatics, with glasses and without, were examined, and when we were done we had data in abundance and very little if anything else, except "experience." One fact was so obvious that it interested us. When monochromatic light was in question the vast majority, 19 out of the 23, found some shade of *green or orange* the tint of choice. Further than this we found that the tint of choice in any given case depended very much on the character of the paper, its texture, color, finish, and also on the ink. For reading some printed work a given person would prefer green and for something else orange.

It should be stated that the complementary tints were carefully determined and the strength of the absorbent solution was just suffi cient to block this complementary. The light was distinctly tinted; it was not monochromatic. When it came to monochromatic investigation no two would agree on the best color for any given piece of paper, nor would the same person decide twice alike. In other words, so far as is yet known, the experiments with the monochromatic lights have given no rational result.

From some of the data obtained the conclusion would be justified that, in proportion to the absolute light sensitiveness of the individual, so much more numerous were the chances that orange would be the tint chosen. In fact, by decreasing the amount of illumination we could enforce the choice of green. A person who would insist that green was painful when the illumination was 0.04 candle power would insist that green was the only color when the illumination was 0.0025 equivalent candle power.

With even this minimum of light some persons would read the special print without the least sense of the light being "dim," provided it was of just the right tint. Another curious fact was that when the amount of light was thus reduced, the sense of color, tint or hue was utterly lost. No one seemed to know what the color was or that there was any. Attempts to use two tints on the same page failed quite.

The necessity for using special print was very soon seen, and five distinct prints were used, part newspaper and part book print. Three pieces of typewritten copy were used with success. But the most satisfactory tests were made with the regular Snellen test types. In these the absolute space is equally divided into black and white, but the size of the squares rapidly diminishes. It was very interesting to note the difference in sensibility to contrast when expressed in terms of these types. While it confirmed the conclusion in general it modified it in special instances. Here again no two persons made the same choice, and the tint of election for the two eyes of the same person would differ. But when all is said and done what have Mr. Morton's experiments and my investigations added to the practical knowledge in use before these were made? Simply and exactly nothing at all. It may be very interesting to make the experiment with a tumbler full of water and a card to prove the pressure of the atmosphere; but who would think of entering on an argument to prove the fact of atmospheric pressure? Just so in regard to the question of the suitable color for the walls of rooms and the various hangings. The only available data are those of empiricism, the data of cut and try; and Mr. Morton has gone over a ground which had been investigated before until it may be assumed as true that rooms in which reading is to be done should be finished in a hue of green and the light should be the complement, or the reverse. The room should be finished in red and the light be a Welsbach mantle, if it is intended to use it as a study. These practical deductions from experiment were matters of common knowledge and discussion in the winter of 1882 and 1883. There is nothing remarkable in this.

The remarkable fact is that Mr. Morton did not carry his exploration further. Why did he not use the apparatus of the laboratory and give the commercial data? Should he have an occasion to try again it would be well for him to use a method which would be less expensive. He hints that his luminosity loss was very great; it should have been between 5 and 7 per cent.

The regular laboratory method of the "jacket" filled with a solution will do the work which in this case apparently was to pass the more useful luminous pencil and impede both ends of the spectrum, which is done by hundreds of workmen in New York every night. The men using gas put a bottle containing a solution of copper sulphate in the way of the beam and the users of the electric light use a sulphate of iron solution. Many are so nice in their appreciations that they have the two solutions in a stock bottle and mix them.

Mr. Morton and I have cause to be proud; we have indeed; he experiments and so do I, each in his own way, and reach very wise conclusions and announce them with the dignity of owls, and when we go into life to carry our great boon, this bread of life, to a starving world, the miserable objects dare to tell us to our faces "We have known all this these 20 years and more," and to prove it, too. Yet their empirical knowledge has not got beyond the bottle age. Is ours to be as sterile also? I am sure I hope for a better future.

Separate Gas Producers for the Heating of Retort Benches.

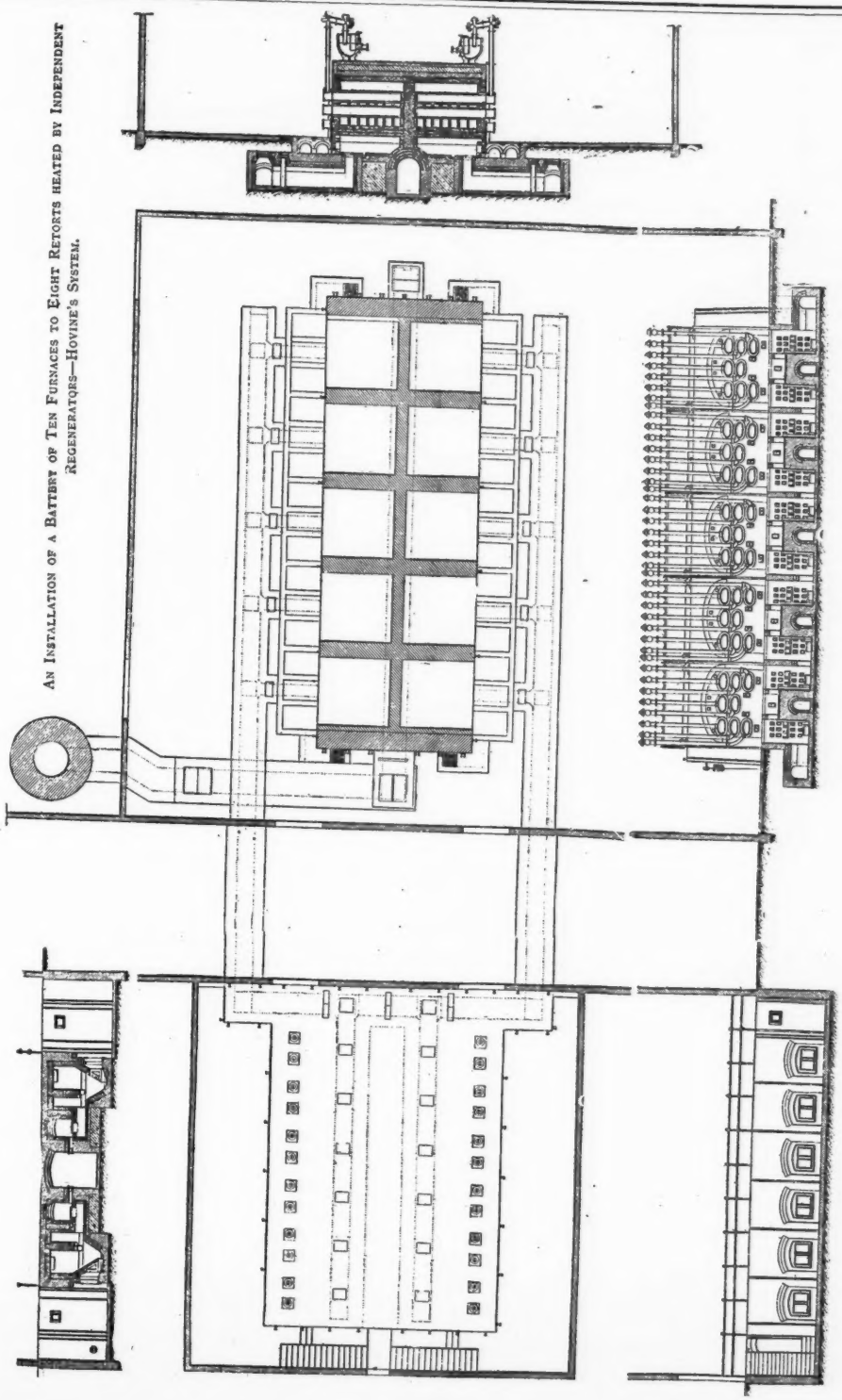
[A paper read by Mr. G. Eichelbrenner, at the International Congress of Gas Engineers, Paris, France, September 3, 4 and 5.]

The installation which I here describe presents some notable differences from those commonly in use. These departures are due to certain special causes; yet I believe that applications of this system can frequently be found. It fell to my lot to completely reinstate a works established near some coal mines on ground which, in consequence of the subterranean operations, was continually undergoing subsidence. Although a foundation of concrete was very thoroughly laid, a completely stable subsoil could not be guaranteed. One therefore foresaw trouble from the settling of the furnace masonry, and it was of the greatest importance to reduce the results of these irregular subsidences of the ground as much as possible.

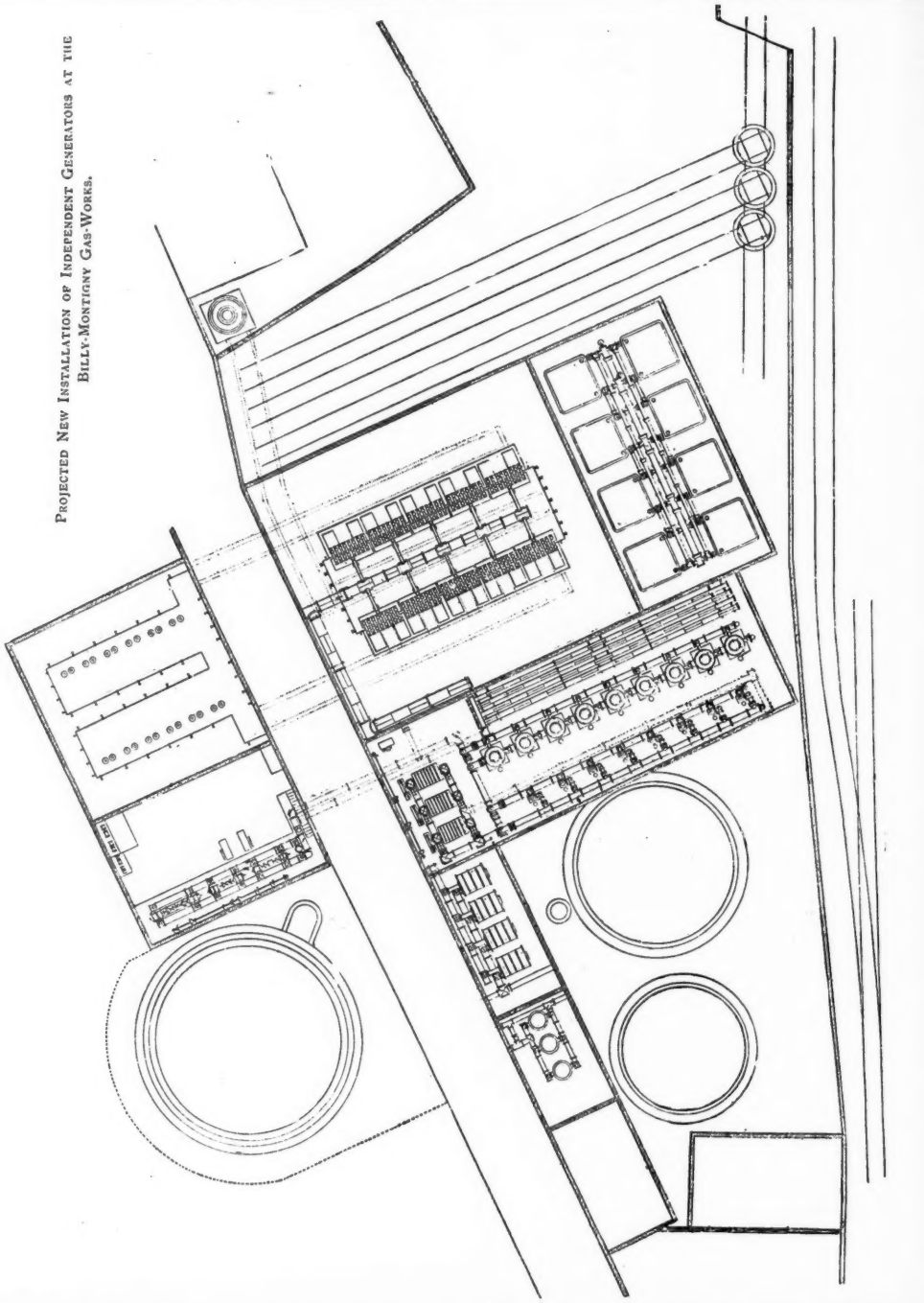
This I sought to do by separating the gas producers from the recuperators. The producers are very solid, and scarcely liable to damage. The furnaces and recuperators, on the other hand, can easily be put out of working order by portions of the recuperators or the retorts getting out of place. But, it ought to be added, the repair of such accidental damage can be done easily and quickly when it does not involve also repairs to worn-out portions of the furnaces or gas producers. Having a sufficient number of spare furnaces, it is enough, in the case of a damaged furnace, to shut off the gas from this furnace, to supply it to another, and, after examining the damaged furnace and closing up any fissures, to put it to work again.

It will be admitted at once that it is the almost general custom, when regenerative furnaces are being used for the distillation of coal, to place the producers close to the retort benches—generally below, or at any rate in front of, the furnace, in the subsoil, and at some very short distance from the main installation. The aim of the constructor is to arrange furnace, producer and recuperators in the smallest possible space, with the object of avoiding loss of heat, which may be very considerable if the surfaces of the apparatus are exposed to the air. Nevertheless, many of the furnaces used for regenerative heating in glass making, metallurgy, etc., have the producers quite separate from the heating chambers. A pipe distributes the gas (from the battery of producers) among the different furnaces, which have near to them only the recuperative plants.

This system, which I have adopted in connection with coal gas distillation, presents several points of advantage, which are not to be despised: (1) It dispenses entirely with the room required for stoking the furnaces, leaving the space around the retorts free for the oper-



An Installation of a Battery of Ten Furnaces to Eight Retorts heated by Independent Regenerators—Hovine's System.



PROJECTED NEW INSTALLATION OF INDEPENDENT GENERATORS AT THE BILLY-MONTIGNY GAS-WORKS.

ations necessary to this stage of the process. (2) It allows the feeding of the producers to be done in the open air. High temperature, dust, carbonic oxide, and steam are thus avoided in the retort house, which cannot be completely free when the furnaces are charged there. (3) It permits the use of fuels of lower quality—such as lignite, peat, and waste material from shale—the combustion of which requires a furnace area for which space could not be found within the limits of the furnaces. Besides, to bring such special fuels into the retort house

would prove a serious inconvenience. This use of inferior kinds of fuel, considered alongside the advances in price of coal and coke, is an important advantage. (4) The furnace, and the producer which supplies it, are rendered quite independent of each other. Owing to the way in which the yield of gas from a producer can be increased, and to the comparatively slight wear and tear of the apparatus when fed with coke, there need not be so many producers as there are furnaces to heat. Six or eight producers will supply eight to ten furnaces. (5) Lastly (and this is a point of which advantage has been taken in many words), heating by producer gas can be done, even when there is water at a short distance below the surface; for the producers can be used at such a distance as not to be touched by the water, whereas if placed underneath the furnace they might be flooded.

Two objections may be urged against this system: (1) Less economy in fuel, owing to the loss of heat in transit. (2) Greater cost of plant. We will take these two points in turn.

(1) This objection falls to the ground where the arrangement of the producers in batteries permits the employment of cheap fuels—such as peats, lignites, etc. The economy in weight may be *nil* or negative; but the economy in money is a fact. Then, if the distance to be traversed by the gas is considerable, and it reaches the furnace cooled, it is easy to reheat it, without any further cost, in a recuperator connected with the recuperator of the secondary air. Supposing that the gas reaches the furnace at 250°, instead of 500° (the temperature at which it leaves the producer). There will be a loss of heat, it is true; but compensation exists in the fact that the waste gases from the furnace are cooled to 250°, whereas if they were used to heat only the secondary air, the temperature on exit would be 500°. If the intervening distance is less, or if the pipe is well insulated, the loss is very slight. It is known that the gasification of coke into carbonic oxide absorbs 23 per cent. of the heat which is needed to raise the temperature of the gaseous product to 850°.[1] If the gas is cooled instead of at once passing to the furnace, there is a loss. Suppose the cooling reduces the temperature to 200°, the loss is—

$$0.23 + \frac{200}{850} = 5.5 \text{ per cent.}$$

of the total heat. But, as Ebelmen has shown, the proportion of the total heat used in a high temperature furnace is very small (4 to 35 per cent.); and hence we come to the conclusion that the loss resulting from the cooling of the gas is of little importance. Yet, as it is a real diminution of the heat realized, it is well to insulate the gas main as thoroughly as possible. In the case above referred to, I laid the pipe in the sub-soil surrounded by refractory earth, and kept it dry. Irregular subsidences of the soil may allow these pipes to sink; but they will not on this account give rise to appreciable leakage, and the escape is very easily put right. It is possible, of course, to make the walls of the producer and the protective coating of the main of such thickness as to prevent loss of heat from the parts above ground. In collecting information on installations of this kind already in use in gas works, I find that the cost per 100 kilos, of coal distilled does not appreciably differ from that when the furnace is placed underneath—a fact confirming the theoretical considerations advanced above.

(2) The construction of this battery, made in the north of France, and during a period of high prices in materials, works out to 1.435 frs. per retort for the installation shown, in which a producer for every furnace has been provided, in view of possible accidents from subsidence. Under normal conditions, eight producers would be sufficient; and the cost per retort would be 1.355 frs.

A similar battery, but with producers underneath the furnaces, would cost, under the same local conditions, 1.250 frs. per retort. The difference in the original cost is thus from 100 to 110 frs. per retort, or 8,000 to 9,000 frs. on the total cost, which is about 8 per cent. more. Recollecting that this plant can burn coal as well as the coke for which it was designed (which cannot be done with sub-furnace gas producers), I am inclined to believe that the advantages of the system are distinctly practical, and that the method can be successfully applied in numerous other cases.

In these experiments, I have collaborated with M. Hovine, an expert in matters of this kind; and I am sure that we shall obtain excellent results in the regular use of the furnaces, an account of which I shall be happy to give next year. All my condensing and purifying plant is arranged in series; and I can therefore make use of those necessary at a given moment. I shall have others put up as the make increases, without altering the buildings, plant, or mains already existent.

1. See Lencauchez, "*Traite des Combustibles*," pp. 225 *et seq.*

(Concluded from Page 571.)

Systems and Apparatus for Light and Power Distribution.—No. II.

[A paper read by MR. C. P. STEINMETZ, at the Convention of the Association of Edison Illuminating Companies.]

In the converter the actual armature current is the difference between alternating and continuous current, and the armature reactions neutralize, thus a very small conductor section is used to secure best commutation, and very high nominal armature reaction to secure high output and stability. A double current generator used as a converter is more liable to hunting, and a converter as double current generator to sparking and heating. It is essential for the efficiency and reliability of operation of such a system to choose the simplest possible arrangement and the least number of transformations of power. Wherever, therefore, the sub-station can be reached with 6,000 or 10,000 volts, a direct generation of the transmission voltage is preferable to the use of the step-up transformers. The 6,000 or 10,000-volt generator is just as reliable and efficient as a low voltage machine.

One important feature to be considered in the design of the generating station is, nowhere to bring the total power, or even a very large part of it, close together. Thus the cables leading from the generators to the bus-bars, and the feeders issuing from the bus-bars, should be separated in a number of different conduits as far apart from each other as possible. We must consider that at the voltages and powers existing in such stations a short circuit in a cable is liable to destroy, or short circuit any cable within 10 feet distance, or more. In a lesser degree the same applies to the sub-station. The high voltage conductors, bus-bars, etc., should preferably be kept away from the operating switchboard altogether, the instruments supplied by transformers and all switches operated by relays, to secure safety to life. A further important feature, in stations where the power is transmitted by cables, is the protection against excessive rise of voltage as caused by resonance phenomena in making and breaking circuit, etc., the more as insufficient protection of the cable usually does not make itself felt immediately, but shows as a rapid deterioration of the cable, breakdowns beginning to occur after some months, and then appearing with increasing frequency.

Where overhead lines and cables are used in the same system, lightning prtoection must be provided wherever a cable joins an overhead line, and every such place constitutes a weak point of the system.

In the consumer's circuits the power is used: (A) as continuous current 3 wire system with about 250 volts between the outside conductors, for the central part of the distribution; (B) as alternating current for outlying districts and pioneer work; (C) as constant current, either continuous or alternating, for series arc lighting.

(A) To change the 3-phase power received from the generating station to 250 volt, constant potential, continuous current, the rotary converter is the most suitable apparatus. It requires step-down transformers. In the chain: Generator, transmission line, transformer, converter, the transformer is the weakest link regarding overload capacity, since at overloads the temperature of the transformer rises at a much faster rate than in the converter or the generator. In all these apparatus the losses consist of two parts—a constant loss, practically independent of the load, as hysterisis, friction, shunt field excitation, and a loss increasing with the square of the load: I^2R in the main conductors and brushes. Obviously where the latter loss is small and the main conductors so imbedded in the iron as to transfer their heat rapidly thereto, as in the converter, and to a somewhat lesser extent in the generator, the temperature rises quite slowly with the load, being rather proportional to the total loss in the apparatus. In the transformer, however, the conductors must of necessity be massed together and separated from the iron, so that the temperature of the coil is more independent of that of the iron. That means that at double load, where the loss in the conductor is four times as large, the temperature rise will be very much greater than in the converter for instance, where, at double load, the temperature rise may be increased only 50 per cent., or even less. Since in emergencies an overloading may not always be avoidable, especially in a system where the first consideration is to maintain the service under all conditions, it appears to me advisable to select the transformer capacity very liberally. For the same reason I prefer air-blast transformers for this class of work, since the air as expansive fluid reaches everywhere, and therefore the liability to local heating is small, while with oil as cooling medium, due to the sluggishness of the oil stream, pockets may be formed in which the oil does not properly circulate and a destructive local rise of temperature is liable to occur. It

is desirable to give each converter unit a separate bank of transformers, since when operating several converters from the same transformers, a pulsating cross current flows between them, if the position of the brushes is not very carefully adjusted, and causes sparking and heating.

The simplest, and thus the most reliable arrangement, is to consider the converter and its transformers as one piece of apparatus, put in and out of service together, and connect converter and transformers permanently together on the low potential side by conductors of the least possible length. With the heavy low voltage alternating currents in these conductors, self induction and mutual induction easily become formidable with any greater lengths of conductors. The only case where the possibility of transferring any converter to any transformer would be of advantage is, if one converter and a transformer of another converter are disabled simultaneously. It appears to me by far preferable, however, in this rather improbable case to heavily overload the remaining units than to go to the excessive complication inherent in a transfer device.

The converter unit can consist either of two machines of 125 volts, connected between neutral and outside conductors on the three wire system, or of one 250 volt machine. The former has the disadvantage to commutate the current twice, but the advantage to establish and maintain the neutral. It is usual in continuous current generating stations, where face commutator machines are used, since this type of machine lends itself best to 125-volt construction.

For the rotary converter, however, 250 volts is far preferable to 125 volts, since it requires to communicate only half as much current, and gives a better machine regarding commutation, efficiency, etc. Thus 250-volt converters are preferable, and are more economical also regarding space.

In case of their use, the neutral can be fed: (a) From a pair of 125-volt machines or an equalizer set; that is, two 125-volt machines on the same shaft, connected in series across the circuit. (b) From the storage battery where used. In either of these cases the voltages of the two sides of the system are independent of each other; that is, can be made unequal if desired. (c) From a pair of alternating compensators connected to a rotary converter. In this case the two voltages are necessarily equal, and thus to produce a difference, a booster is required in the neutral, which may be driven by the converter. (d) A continuous current converter. This is a 250 volt commutating machine, connected across the outside mains, but supplied with two pairs of collector rings connected with equidistant points of the armature. Two compensators, or auto transformers, are connected between these collector rings and joined with their common center to the neutral. Here the two voltages are equal also, and thus a booster desirable, which may be driven by the continuous current converter. The continuous current converter in some features, as the absence of armature reaction, the increased output, etc., shows a similarity with the synchronous rotary converter, except the synchronous feature is absent.

The disadvantage of case "a" is that two 125-volt machines must always be maintained in operation. The disadvantage of "b" is that with any noticeable unbalancing o the system the two halves of storage battery are charged and discharged unequally. The disadvantage of "c" is that always at least one converter with compensator and booster must be maintained in operation. The disadvantage of "d" is the use of an additional machine. Thus which arrangement is chosen depends rather on the conditions of the individual case. Since with the change of load the bus bar voltage of the sub station is varied, the voltage on the converter commutator must be varied, by varying the alternating impressed voltage. This can be done either by varying the ratio of transformation of the step down transformers, or by the insertion of potential regulators. The ratio of transformation of the step down transformers is varied by cutting out primary turns by a dial switch attached to the transformer. This arrangement necessarily is a step by step method, but sufficient y close for almost all purposes, except perhaps for slightly shifting the load from one converter to another. It has, however, the disadvantages that, when the converter voltage is high, a part of the transformer winding is unused. The potential regulator, of the induction type, consists of a three phase transformer with movable secondary, the primary being connected in shunt, the secondary in series to the circuit. By the motion of the secondary the phase relation of the secondary voltage is varied so as to change from additive to substractive. The induction regulator gives a perfectly gradual variation of voltage and has the great advantage of affording, by its self-induction, a flexible connection between converter and generator. This is very desirable.

In a converter or synchronous motor circuit, we have two independent e. m. f.'s, that of the generator and that of the converter, connected in parallel, and thus if these e. m. f.'s are not exactly corresponding to each other, a cross current flows between the two machines, which is limited only by the self-induction of the circuit. Thus self-induction is necessary and essential in a synchronous motor or converter circuit. Step-down transformers and converter armature offer some self-induction, which with proper care and control of the field excitation may be sufficient, but the reliability of operation is greatly increased by the insertion of an additional self-induction, as that afforded by the induction regulator. The induction regulator, however, is considerably more expensive than the step by step control of the dial transformer.

A storage battery may be used in the converter sub-station with the same advantage as in a continuous-current generating station. Since the storage battery must be able to discharge at the highest voltage required in the system, and the charging voltage is from 20 to 25 per cent. above the discharge voltage, it follows that, if the storage battery shall be charged directly from the converter, an additional margin of voltage of 25 per cent. must be provided in the latter. This is extremely undesirable, since it brings the range of voltage variation outside of that which conveniently can be covered by an induction regulator, requires the converters and transformers to be 25 per cent. larger, and, what is the most important feature, requires such changes in the constants of the converter, which make it in every way a less desirable machine, especially regarding hunting and efficiency. That is, a converter intended to operate anywhere between 220 and 320 volts cannot be made as good and reliable a machine as one intended to cover only the range from 220 to 270 volts, for instance. Therefore, it is preferable to charge the battery through a series booster, which may be driven by the converter. In this case, however, the booster may also be used in the discharge of the battery, the end cells and the trouble and complications caused by them entirely avoided. The preferable way of installing the storage battery appears to be to connect permanently in series as many cells as give the mean bus-bar voltage at open circuit, and connect it to the system through a series booster. In charging, the series booster adds to the station voltage the increase required to give the charging voltage. In discharging it adds to the battery voltage the amount required to bring it up to the bus bar voltage. In either case the booster is generator.

(B) The second class of work done by a sub-station is alternating current supply to outlying districts. While in some places alternating supply will always remain preferable, in others the ultimate development is toward continuous current, by small transformers supplying individual customers, larger transformers on secondary circuits supplying several adjacent customers, a secondary network with large transformers, a system of 3-wire mains, first fed by large transformers, then by feeders from a converter sub-station with continuous current. The preferable alternating system thus is one permitting the operation of a 3-wire system; that is, either a single-phase system or a ½-phase system with common return. The unbalancing inherent in the latter is usually not objectionable, since long before the drop in the mains becomes serious, the change to continuous current occurs.

Where the frequency of the generating station is 60 cycles, step-down transformers are all that is required, changing from 3-phase to ½-phase, where the current exists. Otherwise either a 4-wire, 3 phase distribution, or a system of 3-wire, single-phase lighting with 3 phase power is preferable as simpler and more efficient.

With 25-cycle generation, motor generators or frequency converters are needed. With motor generators, per 1-kw output, 2 kilowatts of machinery are required, with frequency converters only 1 kilowatt, of which a part, however, is of a more expensive type. In the latter case, just as in the rotary converter, the secondary voltage is proportional to the primary, so that, to vary the voltage, potential regulators are needed. Obviously the frequency converter when changing from 25 to 62.5 cycles, for instance, at the same time can convert from 3-phase to ½ phase or single-phase. An induction regulator in the primary controls the whole system, or individual secondary feeders are controlled by separate potential regulators, preferably of the magneto type.

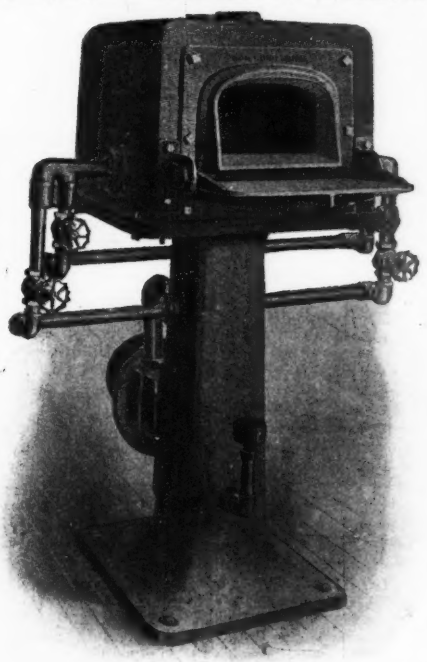
(C) For series arc lighting either constant alternating or constant continuous current can be used. With the 60-cycle generating system, alternating arc lighting supplied by constant current transformer or equivalent apparatus is decidedly preferable in simplicity and efficiency.

With a 25 cycle generating station series arc lighting can be done: (1) From arc machines driven by synchronous or induction motors. This arrangement has the advantage to require power and current

only proportional to the load, but since the number of arcs which can be carried by one machine is limited in large amounts, a considerable number of machines are needed, and the space economy of the arrangement is rather low. (2) Constant current transformers and rectifiers may be used. This arrangement is somewhat more efficient, but the light load and even full load power factor is low. At no load just as much current is required as at full load, and the arrangement is thus undesirable wherever the circuits cannot be operated always at fair load. Like in the first case, a considerable number of individual apparatus are required, which, however, takes less space. (3) The series arc lighting can be put on the alternating system, that is, the frequency converter or motor generator, and operated by constant current transformers. With the enclosed arc lamp the alternating arc lighting has become very satisfactory. The objections are the low power factor and apparent efficiency at light load. (4) Series arc lighting can be done by alternating current from a special moto driven constant current alternator. The advantage of using an alternating arc machine is that, instead of many smaller machines, one large machine unit can be used, feeding a number of arc light circuits over series transformer . In this case also arc circuits of different voltage and different current can be operated from the same machine. In this system low voltage indoor illumination can be provided by operating in series with transformers feeding high voltage circuits of many lamps, other transformers feeding only one or a few lamps at safe potential. By using separate constant current alternating machines of large capacity, the objection to the low power factor of alternating arc lighting disappears, and a higher frequency can be chosen, which has some advantages for arc lighting.

A Tool Room Gas Heating Furnace.

The accompanying illustration affords an excellent key to the form of a new gas heating furnace that is being put upon the market by the Chicago Flexible Shaft Company, 158 and 160 Huron street, Chicago. It is especially adapted to heating tools, dies, taps, milling cutters,



reamers, etc Entire seclusion from the products of combustion can be maintained, which is a feature of importance to be considered when heating valuable tools. The gas and air supply valves are conveniently placed, enabling the operator to adjust them accurately. The furnace is so arranged that the muffle can be removed and a clay slab substituted, transforming it into an oven furnace. The base is hollow and serves as an air reservoir. The blower is directly connected. The furnace can be set up in any convenient place and belted directly from the main shaft. The linings are extra heavy, reducing the radiation to the minimum. This furnace will burn gasoline, illuminating or natural gas without soot, smoke or odor. The cost of operating, using ordinary city gas, is claimed not to exceed 5 cents per hour.

Coal Exports.

The *Engineering and Mining Journal* says that a novel situation is now presenting itself to American coal operators. For the first time in our history we find a considerable dem nd for American coal abroad. Large orders are reported from various European countries, especially Russia and the Mediterranean States, and shipments are being made on a scale heretofore unknown. The situation is an interesting one, and deserves careful consideration.

The coal exports of the United States, notwithstanding our large production, have been heretofore limited to our neighbors, Canada and Mexico, with comparatively small quantities to South America. With Europe we have had practically no trade, so that the opportunity now presented is to establish an entirely new trade. The present situation in Europe is due to a period of unusual trade activity, combined with the conservatism of European operators, which has prevented them from taking such measures to meet the demand and increased production as would naturally suggest themselves to Americans. To this is added in France and Belgium the impossibility of increasing production to any considerable extent; and in Germany the close control of the coal trade by syndicates, which have adopted the short-sighted policy of exacting a large immediate profit from the necessities of manufacturers in preference to preparing for larger trade in the future. For the time the difficulty is a pressing one, though probably the alarm is greater—or at least noisier—than is really warranted.

If we are to cultivate foreign trade it is well to examine the ground carefully, and thus avoid wasting effort. Thus we do not believe that there is any probability of the establishment of a large coal trade with Great Britain; or, indeed, of anything more than a few special and exceptional shipments. The coal output of Great Britain last year was 220,085,303 long tons, of which 43,108,568 tons, or 19.5 per cent., were exported. If the home consumption is to increase in greater proportion than the exports, the demand will be met by reducing the latter rather than by bringing coal from abroad. No large export business to that country is to be expected until the consumption exceeds the output; and that is still a remote contingency. Our opportunity is rather to take the foreign customers of Great Britain, the buyers of coal whose demands, apparently, have not been met satisfactorily this year, so that they are looking for other supplies.

The total exports of coal and coke from Great Britain for the 8 months ending with August this year were 30,217, 726 long tons, an increase of 1,474,373 tons, or 5.1 per cent., over the corresponding period of last year. It is interesting to note the distribution of these exports, and we find it given this year as follows:

Russia	2,308,687 tons.	7.6 per cent.
Sweden	1,972,687 "	6.5 "
Norway	898,987 "	3.0 "
Denmark	1,322,417 "	4.4 "
Germany	3,851,809 "	12.7 "
Holland	1,260,868 "	4.2 "
France	5,624,547 "	18.6 "
Portugal	475,966 "	1.6 "
Spain	1,668,562 "	5.5 "
Italy	3,576,684 "	11.8 "
Turkey	241,585 "	0.8 "
Egypt	1,262,071 "	4.2 "
Brazil	537,659 "	1.8 "
Gibraltar	211,693 "	0.7 "
Malta	293,962 "	1.0 "
East Indies	388,102 "	1,3 "
Other countries	4,322,140 "	14.3 "

In addition to the coal thus exported, we find that the coal shipped for the use of steamers engaged in the foreign trade was 7,728,318 tons, which would bring the total up to 37,946,044 tons. In our own returns the quantity of bunker coal for steamers is not given; it has been estimated by various authorities at from 5,000,000 to 7,500,000 tons, and probably exceeds 6,000,000 tons. It has been for years the practice with foreign steamers to fill their bunkers on this side of the water, both

price and quality of coal being better than they can secure in Europe. Outside of Great Britain there is a considerable export of coal from several European countries. The following table shows the exports and imports of the leading nations on the Continent of Europe for the first half of the years given; the discrepancies between the figures here given and those in the table above are due to the shorter period covered by the second table:

	Imports		Exports	
	1899.	1900.	1899.	1900.
Germany	2,217,673	2 651,250	5,543,999	6,483,976
Holland	1,893,116	2,347.759	160,674	402,429
France	5,698.040	7,036,830	645,561	639,170
Belgium	1.236.335	1,675.353	2,068,258	2,468,590
Italy	2,294,639	2,079,483	....	....
Spain	768,083	723 954	....	....
Austria-Hungary	2,106,248	2,728,163	2,728,163	215,130

On investigating the trade of these countries, however, we find that the coal exports are almost entirely to contiguous countries, and very much in the nature of local trade. Thus Germany exports to Holland, Belgium and Russia; Belgium to France and Germany; Austria to Germany; and so on. None of them ships any considerable quantity beyond seas. Imports are, of course, very largely from contiguous countries, except in the case of France and Italy, whose imports are chiefly from Great Britain. The German imports of English coal are mainly at Hamburg and Bremen, and are not large enough to have a national influence on its coal trade.

We see, therefore, that the main reliance of Europe for any supplies of coal needed beyond what each country could draw from its own mines, or those of its immediate neighbors, has been upon Great Britain. Heretofore that country has had an abundant surplus to sell them, but now its own demand is increasing faster than the capacity of its mines. The opportunity is therefore afforded to replace the British supplies by American coal, which we can afford to sell at a lower price than the English operator can, because we can mine it and place it at the seaboard at a lower cost. The main question on which, at present, the development of this trade rests, is that of ocean freights. Just now the condition of the shipping market is rather discouraging to exporters. The absorption of a very large number of vessels as military transports, by the British to South Africa, by several European nations to China, and by the United States to the Philippines, has removed from competition most of that floating element which is usually hunting for tonnage and keeps down rates. There has not been time to enlarge the number of vessels to any great extent, and it promises to be a long time before any considerable number of the transports are released for general trade. This state of things will pass away in time, however; vessels will be available and rates lower. If we are to build up a permanent trade, however, there should, and probably will, be a corresponding fleet of vessels to carry it; and it is quite possible that in a few years we may see lines of ocean steam colliers owned by the Pennsylvania, the Baltimore & Ohio, the Norfolk & Western, the Chesapeake & Ohio, and other important lines which deliver coal at the Atlantic ports. If we wisely apply the lessons we have learned on the Great Lakes, adapting them to the varying conditions of the Atlantic, we ought to be able to carry coal at rates far below those now prevailing, and low enough to leave a good profit to the mine operator on his foreign sales.

The present prices at which good bituminous coal can be had for export range from $2.10 to $2 35 f.o.b. Philadelphia, Baltimore, Norfolk or Newport News. Recent charters of vessels have been made at $5.10 to $5.30 to Mediterranean ports, and 50 to 75 cents lower to English Channel ports. At these rates good steam coal could be placed, say at Marseilles, for about $7.50, or nearly $1 less than Welsh coal now costs there.

In entering upon this trade we must remember that the present industrial pressure is going to slacken after a time—indeed has already begun to do so. Demand will lessen, and prices will decline. What ever trade we secure now can be held in future only by furnishing good coal and selling it at a lower price than it can be had elsewhere. In countries such as Germany, which are themselves large coal producers, foreign coal can only be sold in very small quantities, when trade is slack and demand at a low ebb. In countries such as Spain, Italy and Holland, which produce little or no coal, or like France, where the production is normally less than the consumption, there will be always a chance to sell coal, but in the face of much keener competition than at present, and, consequently, much lower prices.

We have spoken here only of the European trade, because that is at present the most important. With the countries on this side of the Atlantic—the West Indies, Mexico and South America—we have already an established business, which is sure to increase; and it requires only ordinary trade sagacity to give us the advantage of our rivals. We do not think there is much opportunity for coal trade with the East, since the Eastern countries are already supplying themselves with coal to a large extent, and with the industrial development which is already well advanced in Australia, in Japan and its dependencies; which is started in the Dutch East Indies and Eastern Siberia; and which will come in time even in China; the East will be well able to take care of itself.

There is another view of the coal question to which space will permit us to refer very briefly now. The industrial power of a modern nation depends very largely on its supplies of cheap fuel. Other things being even, the nation which has the cheapest coal has a long start in the commercial race. When to this fuel supply is added, as in the United States, an abundance of raw materials of almost every kind, and a population industrious and intelligent enough to take full advantage of its opportunities, can there be any doubt where the industrial and commercial supremacy of the world will rest?

Electric Traveling Cranes.

[A paper read by Mr. A. D. Williams, before the Pittsburgh Foundrymen's Association.]

In nearly all foundries cranes are employed to do heavy lifting, and the overhead traveler, in most cases using electric power, has become a very desirable part of foundry equipment. The idea in this paper is to consider the multimotor electric crane from the user's standpoint, taking up its desirable and undesirable features, without attempting to give a detail treatise on crane designing. The only machines that never break down are those which are never used. Cranes are no exception to this rule, and the natural depravity of inanimate objects always causes the selection of such a time as will result in the greatest possible inconvenience to all concerned. Many serious crane accidents have occurred, and some of these are no doubt fresh in the memory of Pittsburgh foundrymen.

The slings used in handling loads are really not part of the crane, but they are a source of trouble. Chain slings are the best, they are flexible, do not chafe, and damage to finished surfaces can easily be prevented by a little care in using. Their periodical inspection is necessary, and they should be annealed from time to time. Rope slings are liable to cut and are uncertain. In many places their use has been stopped, after an accident has cost more than a good set of chain slings. For hoisting purposes chain is most commonly used on account of its flexibility; this means smaller drums and sheaves, and a higher hoist than can be obtained on the same crane with wire rope. Only the best grade of tested chain should be used. As this becomes fatigued by long use small cracks may develop. Its durability, of course, depends on the service the crane gets, and defects are not easily detected. Chains should be kept well lubricated, and annealed occasionally.

Where wire rope is used its condition is readily seen, no expert being required. In this respect it is safer than chain. Extra flexible wire rope is manufactured which is well adapted to crane service on account of the moderate size of the sheaves and drum required. It is not an experiment for hoisting purposes, but its use on electric cranes is not as common as it would be if its good qualities were thoroughly appreciated.

Hooks are made of various materials. Forgings of wrought iron and steel are used in many cases, but malleable iron and steel castings are also employed. Malleable castings are only used for very light sections. For heavy work forged hooks are universally employed, and cast steel hooks have been used for medium size cranes. A first class steel casting is much better than a poor forging, though the material to be specified is largely a matter of individual preferences. With proportions suited to the metal, it makes very little difference what is used; the chances of flaws are about even, and a burnt forging is not any more reliable than a defective casting.

Some cranes are so constructed that in hoisting and lowering the load is twisted more or less around a vertical axis; this necessitates extra care in its guidance. This style of hoist is not well suited for foundry purposes, as the attempt to correct this twisting can be very easily overdone with disastrous results. For the foundry a vertical hoist without any twist in it fits the bill best, and for almost all purposes is the most desirable.

The electric motors, controllers and wiring on cranes should all be arranged and constructed so that repairs can be easily and quickly

made. Perfect insulation is impossible, as all substances conduct electricity more or less. There are a number of grades of insulated wire, and a good quality run on porcelain insulators or in molding arranged so that no two wires can come in contact with each other or with any metal should be insisted upon. Nearly all the electrical troubles with cranes arise from imperfect insulation. No detail is too small to be slighted in this respect, as fine dust and "flyings" are liable to settle anywhere, and a ground or short circuit from this cause may be expensive. Wooden battens should be used to prevent the trolley from swinging against the girders, but wood alone should never be depended upon as an insulator.

Crane controllers are important, as the entire manipulation of the machine depends upon them; this, like the clutch of the mechanically operated crane, is a weak point. The practically perfect crane controller is yet a matter of the future. All parts should be accessible, and so arranged that those subject to wear can be removed and replaced with a minimum amount of trouble. The resistance coils should be arranged so that close control over the crane can be obtained, as without it delicate handling is impossible. The device by which the operating levers are centered, or held in the position at which the current is off, should be so positive that the operator is not likely to throw the lever too far and reverse unintentionally. Any weakness in this device is a constant source of danger, yet it is desirable to have easy working controllers.

The electric motors used should be inclosed in dust proof casings; those built for crane service by the large electrical concerns are very compact and accessible; their designers have had the benefit of wide experience gained in street railroad work and the motors they produce give very little trouble. Standardization of all parts has been followed out, so that repairs are in most cases very simple and extra parts can be carried in stock. Special motors are things to be avoided; a bill for repairs would furnish sufficient explanation. The armature and commutator of a motor are its two most vulnerable parts, and it is much easier to remove them when attention is required than to attempt their repair in place. In most cases removal is absolutely necessary. A set of spare armatures adds to the cost of a crane, but it will save a delay at an inopportune time, as slight faults can be corrected which, if given time to develop, would prove expensive.

Crane brakes or safety devices are of two kinds, one which acts up on the interruption of the electric circuit for any cause, the other operated by the load. The former is generally called the magnetic brake, because it is thrown out of action by magnetism, being thrown on by a spring or by gravity. The force of gravity is not very likely to fail; springs are not so reliable. The braking effect is obtained by a cast iron drum keyed to one of the shafts (preferably the armature shaft), where its effect will be greatest, and a brake strap acting on the drum. This strap is often made of sheet steel and its friction surface fitted with a renewable lining of wood, leather or other suitable material. Naturally this brake strap requires adjustment from time to time to take up the wear. This brake is made single or double acting. Its principal duty is to overcome the inertia of the armature and to stop the load promptly. It should, however, be of sufficient size to hold the load. The designing of one of these brakes presents some interesting problems. Too little of it is only an aggravation, and when too large it is troublesome and may twist a shaft in two by stopping one end before the other. A modification of the Weston disk brake has also been successfully used as a magnetic brake.

The load brake, variously called the automatic brake, safety retaining clutch, mechanical brake, etc., is made in a number of designs by different makers. The basic principle is the same in all. The tendency of the load to run down acts to set the brake, which is arranged to permit hoisting freely. In lowering the motor acts against the tendency of the load to lock the brake, and the load cannot move until these two forces balance each other; the brake absorbs the acceleration of gravity on the load so that it can only drop at a speed proportional to that of the motor. It might be said that the motor has to push the load down; this does not describe the action accurately, but it is close to it. It is highly important that the operation of this device should be smooth. Any irregularity in its action causes the load to descend in a jerky fashion, which means excessive strains in the whole structure and tends to develop defects. While no apparently serious results may appear at the time, there is the ever present risk that some part may have been overtaxed and cause a seemingly inexplicable breakdown in the future.

The mechanical elements of a crane are very simple, a few gears, track wheels, shafts, the motors, drum, brakes and the necessary framing to support and hold the mechanism is about all there is to the trolley, but it will not do to put this together in "any old way." The phrase, "in a workmanlike manner," is susceptible of various interpretations, as there is no particular standard, and each one must judge according to his own lights. It is hardly necessary to say that cost counts in cranes as in everything else. The crane builders are not in it for pleasure and the shop facilities as well as the number that can be built from one set of patterns are important; all changes add to their costs and the endeavor is to set up a set of standard sizes that will enable them to suit the general run of customers, with most of whom the price decides the question. The maximum amount of trolley travel calls for a short trolley. The minimum of headroom can only be entered by a low trolley. The maximum amount of hoist can only be obtained by a trolley which can be placed close to the roof chords. Ease of repair requires that all parts shall be arranged so that any piece can be removed and replaced with a minimum amount of trouble and labor. All bearings should be capped, as shafting has a habit of getting bent so that it is impossible to remove it from a solid bearing without cutting it to pieces. With hack saws this is a tedious job, but it can be done very rapidly by burning the shaft in two by an electric arc, provided power enough is available. With capped bearings bent shafts can be removed and straightened—perhaps they ought not to become bent, but it does happen, just the same. With cranes it is not easy to make repairs, the space to move around in is limited and the risk of a tumble makes a man cautious; one hand is often only available. This fact is not as thoroughly appreciated as it should be by crane designers.

Crane gears are important items, particularly as they wear out in time. Cast iron gears, if properly proportioned, work well, but it is a good plan to have pinions of steel. In this combination the pinion wears out before the gear. In a great many cases a little more pig iron would improve the gears. Where this is the case cast steel can be used to advantage in making repairs, as owing to the limitations of space, etc., it is rarely possible to make any change in the main dimension.

Lightness is particularly important in a crane, as it counts in the girders requisite, but a crane that is too light is continually giving trouble, and in the long run it costs more than a heavier machine.

Safety devices of different kinds are occasionally employed to prevent overhoisting and running the trolley or bridge full tilt into the end stops as commonly designed. Their utility is questionable, for the crane operator can hold the circuit breaker in and at the same time use the controller to get back past the safety line. The best arrangement of such devices is to so place them that the operator will have to call assistance to hold the circuit breaker in until he can run back to a point where it will stay closed. When the operator finds that he gets caught in this way it is only a matter of time before he discovers a way to get around the circuit breaker. Overhoisting generally brings a pretty good strain on the mechanism. It is very likely to result in broken chain sheaves and a bending of shaft. One accident of this kind is about all a crane operator should have charged up to him, and unless he loses his head the results are not very serious. Running the trolley or bridge into the end stops at full speed is a very efficient way of testing the strength of the crane girders and runway, but there is a certain amount of danger in it, so that it is not advisable to do this intentionally. It is an expensive job if anything fails, and more than one crane has refused to stop at the end of the runway. This accident has also been caused by high winds, showing that for a yard crane a good anchor is necessary. The longitudinal and lateral strength of a great many crane runways is much lower than it should be, as only the static loading is considered and the roof trusses are depended upon for sway bracing. As they are not designed for this, the whole building is easily swayed in both directions by the crane.

The track wheels are depended upon, in most cases, for keeping a crane in line, or square, on the runway. These wheels should be of the same circumference. Double flanged wheels of cast steel or cast iron with chilled treads are used; both materials give satisfactory service. Chilled tread wheels should have their flanges made in sand, as otherwise there is considerable liability of the flanges breaking off in case the crane gets badly out of line or the runway varies from gauge. With steel wheels the liability of breakage is diminished, but being soft the tread is likely to wear. The flanges are sometimes rolled over and spread apart by a poor runway. The result of this in the case of driving wheels having a gear mounted on their hub is that the gear is forced over so that it cuts into the truck beam. The removal of a steel wheel when this has occurred is a very pleasant piece of work.

It is almost impossible to keep a crane absolutely in line or square,

but if proper precautions are taken it is possible to get very fair results. The line shaft should be driven as nearly midway between its ends as practicable, and is preferably a little too large than too small. It may be well to say that what is large to one man may seem small to another. When the line shaft is driven near one end there is a certain amount of torsional spring to it that permits one end of the crane to lag behind, producing a racking action that does not improve the wearing qualities of the machine. This same effect can also be produced by starting the bridge travel suddenly with a heavy load close to one end. It is perfectly practicable to connect the girders and track beams so that this injurious racking tendency can be, to a large extent, overcome, but it is not often done.

Runways that are out of line or not level, or a combination of these two defects, do not have a good effect on a crane and cause excessive wear on the bridge driving mechanism. The correction of runway imperfections is comparatively simple, but unless the structure is very thoroughly braced it will soon be as bad as before.

There are a number of types of crane girders, two connected at the ends being used for all except very light machines. The single webbed plate girder was extensively employed at one time. The bottom chord, however, has a tendency to vibrate considerably when the crane is in motion. This is increased by sudden starts and stops. The weight of the line shaft and motor causes torsional strains and the metal is not well distributed to resist them. Rapid starting and stopping increase these strains. This type of girder is not suited for high speed cranes unless sway bracing can be used; in this case the trolley is placed between the girders and runs on the bottom chord. Where the trolley runs on the top chord a system of auxiliary latticing can be used, making in effect two girders at right angles to each other, and by this means a high degree of lateral stiffness can be obtained at the sacrifice of simplicity.

The double webbed plate or box girder is the simplest form used in crane work; the metal is well distributed to resist all the strains met in service, the rivets can all be driven by machine, the use of stiffeners for the web plates can be avoided by using distance pieces and bolts or long rivets to hold the webs. These girders can be made as stiff as desired laterally and vertically. Occasionally a girder of this kind is made very deep and light web plates used, but this sacrifices almost all the stiffness and is not very good practice. The principal disadvantage of the box girder is that there is no way to inspect or paint the inside.

Lattice girders are used extensively for yard cranes on account of the small amount of exposed surface. They are also employed for long span indoor cranes. The trolley can be placed on either the top or bottom chord to suit the conditions met with.

The failure of crane girders is comparatively rare, as they can generally hold a considerable overload; nevertheless it is not a good plan to use a crane for anything heavier than its rated load, as this has a tendency to develop weak spots that in the future may cause trouble. In some cases a 5-ton crane has handled nearly 20 tons, but the operator was taking big chances of spoiling the machine and starting several funerals.

The effect of impact on cranes is often neglected. In rapid working these stresses may be equal to those due to the dead load, so that the factor of safety is only one-half of what it would be if these stresses were taken into account in the first place.

In the foundry, as well as in some other places, it will be found that the electric overhead traveler furnishes no panacea for difficulties inherent to the handling of heavy work, though it is a valuable accessory. A large part of its calls are for turning molds, lifting copes, etc., which are too heavy for the molder. Very often it is necessary to hold such a load for some time, while there may be other floors waiting and losing valuable time.

The old foundry jib crane should not be discarded on the advent of the traveler, but rather should be reinforced by a number of light jib or post cranes, so that the traveler can be used at its maximum efficiency on lifts proportionate to its capacity.

A great many crane break downs are due to carelessness or forgetfulness on the part of the crane operator. For instance, he blocks the gearing with a bolt or nut while making some slight repair, then starts the machine, and the firm send out a rush order for new gears.

It is a good plan to carry a set of spares for all parts likely to become disabled or worn out in service; this avoids expensive express charges and the extra cost of rushed work. In ordering such spares it should be specified that each piece shall be properly marked so that it can be easily identified.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

It is with considerable satisfaction that we make the announcement that Mr. Morris W. Stroud has been elected President of the American Gas Company, vice Mr. John C. Lowry, resigned. Mr. Stroud served the Company faithfully and well for quite a period as its Secretary and Treasurer, and his promotion to the place of its chief executive is a pronounced and satisfactory recognition of his merit and worth to it. Of course Mr. George G. Ramsdell continues as the Company's General Manager.

Mr. Lowry's resignation was largely prompted by the knowledge that the business of the Company was quite out of line with his former training. He remains on the Board of Directors.

The attention of the gas companies of the country was positively directed some time ago to the shipment of a cargo of American gas coals to the South Metropolitan Gas Company, of London, England. Up to the time of writing, authentic figures, in official shape, respecting the results of the actual use of this coal have not been made public, although one or two of the daily newspapers have given figures purporting to be of the accurate sort. It is needless to say, though, that accredited information in the matter of the South Metropolitan trial will be received here with pronounced attention by the producers and users of gas coals. A correspondent in referring to the South Metropolitan trial of American gas coals, and whose reference to it as above causes this mention, remarks: "This much talked of shipment of American gas coals to Europe was not by any means the first parcel of such coals shipped to Great Britain, for as far back as 1890 Messrs. Perkins & Co., of this city, forwarded to the Gas Light and Coke Company, of London, a parcel of their Ocean Mine Youghiogheny gas coal, which was thoroughly tested by Mr. Alfred Kitt, then Chemist to the Gas Light and Coke Company. The results of that test were made public at the time, and the items thereof may now be found in a pamphlet issued recently by the Perkins Company describing the value of Youghiogheny gas coal. The report shows in round figures a yield of 11,088 cubic feet of 17.66-candle gas from one gross ton of coal. In the report mentioned Mr. Kitt further says that the coal yields a very large volume of gas of high illuminating power. It is bright and clean and gives an excellent coke of high combustible value. The percentage of ash in both coal and coke is exceptionally low, and the proportion of impurities in the coal renders the gas easy of purification. The coal written about, to the certain knowledge of the writer, has been shipped to and received by several of the largest gas companies in South America and Cuba for years, which continued use is good evidence that it has yielded satisfactory results to its purchasers."

The American Bridge Company has commenced making very large shipments on account of the steel work for the subway in this city. Already about 2,000 tons have been shipped, and the material is being sent on at the rate of about 100 tons per day. The complete contract calls for the supplying of close to 80,000 tons of structural material, which is being manufactured at the Keystone plant of the American Bridge Company.

Mayor Smith, of Macon, Ga., maintains and advocates that the gas and water works of that city, which still remain in the possession of the Macon Gas Light and Water Company, should be purchased by the city for operation on municipal account.

The United Gas Improvement Company has been awarded the contract for the construction of a set of its improved, double-superheater Lowe water gas apparatus in the works of the Austin (Texas) Gas Company. This is somewhat different from the original notice of the award as given in the Journal, and may be taken to prove that the proprietors of the Austin Company have reached a final decision.

The organization of the Board of Directors of the Woonsocket (R.I.) Gas Company resulted in the naming of the following executive officers: President, G. A. Buffum; Treasurer, R. G. Randall; Secretary and Superintendent, Z. M. Jenks. The Company is very prosperous.

At the annual meeting of the stockholders in the Brookline (Mass.) Gas Light Company the Directors elected were: H. M. Whitney, R. W. Lord, F. Tudor, Jr., W. L. Elkins, Jr., and G. H. Finn. The Clerk and Treasurer of the Company is F. Tudor, Jr.

Mr. William T. Morris, of Penn Yan, N. Y., has, in connection with his associates, secured the complete control of the properties of the Owego (N. Y.) Gas Light Company. We understand that no change

in the management of the Company will be made until its annual meeting, which will be held the 13th prox.

GENERAL OLNEY ARNOLD, for many years a valued Director in the Pawtucket (R. I.) Gas Company, died the morning of the 4th inst. Out of respect to his memory, the offices of the Company were closed during the funeral services, which were attended in a body by the Board.

THE Glens Falls (N. Y.) Company's works were badly damaged by fire August 12th last. An insurance of $17,000 was carried, and the adjustment resulted in the payment to the loser of the full amount. The actual damage it is said was largely in excess of the face of the sum on the policies.

THE Cincinnati Gas Light and Coke Company will forthwith extend its mains to the outlying district of Hartwell, the Hartwell Council having granted without much fuss the necessary enabling act.

THE Burlington (N. J.) branch of the Consolidated Company for that section proposes to extend its mains to the adjoining districts of Beverly, Delanco and Riverside.

DR. O. R. BUTLER, of Cooperstown, N. Y., seems to be thoroughly disgusted with the results that have attended his lease or sale of the Cooperstown gas works to H. Abrams. In any event the works are shortly to be sold at auction, as per advertisement in the current issue of the JOURNAL, which advertisement is the most peculiar one that we have ever had occasion to print. The Doctor should have little difficulty in getting some one to bid over his reserve figure of $3,000. The plant, if the franchise part of the assets is all right, is certainly cheap at first glance at a price well in excess of the Doctor's promise to quit the bidding field.

THE Racine (Wis.) *Journal* says that the new works of the local Gas Company make a fine addition to the noted manufacturing properties of that city.

IT is reported that the gas and electric lighting interests of Kingston, N. Y., have again changed hands, the Boston owners having disposed of their holdings to residents of Philadelphia, who propose to develop the business of the Company on modern lines. General Manager Tobey is still in charge, with the likelihood that he will be retained by the succeeding owners.

PRESIDENT PORTER, of the Alton (Ills.) Gas and Electric Company, says that the work of extending the Company's system of hot water heating, began last year as an experiment, is to be largely extended.

THE authorities of Steelton, Pa., have finally agreed to an ordinance for the construction and operation of a gas plant.

MESSRS. H. F. WEBBER and E. H. Gallagher, of Ionia, Mich., are the parties interested in the gas works which it is proposed to construct and operate in Traverse City, Mich. Both of these gentlemen are concerned in the management of the Ionia Gas Light and Coke Company.

THE new station meter for the Worcester (Mass.) Gas Light Company, rated to pass four million cubic feet per 24 hours, is ready for work.

MR. C. L. GOEHRING, rst President of the Consolidated Gas Company, of Pittsburg, Pa., died at his home in Allegheny City, Pa., the evening of the 4th inst. He was in his 85th year.

MR. CASSIDY, of Brooklyn, N. Y., had many a political argument with his friend Mr. O'Hara; they were also neighbors. Mr. Cassidy favored the election of Mr. Bryan, Mr. O'Hara favored the election of Mr. McKinley. Mr. O'Hara, in closing the mutual debates, always felt that he had the wrong end of the same, since Cassidy ever fervently finished by cursing the trusts. O'Hara was not at home much, save Sundays, between sunrise and sunset, but O'Hara's wife seldom left the house. This particular evening Mrs. O'Hara told Mr. O'Hara what she had seen that afternoon. Having had his supper, O'Hara met his opponent Cassidy. They talked over the situation, each using quite the same dialogue that each had participated in many times. When the climax came and the diatribe against trusts had been rendered, O'Hara said: "Cassidy, I know why you are so much opposed to the trusts." Cassidy "Wanted to know," and this is what O'Hara told him: "My wife saw a wagon, owned by the Brooklyn Union Gas Company, draw up to your door yesterday afternoon. Less than 15 minutes thereafter the wagon went on its way, and in it was a gas meter that came out of your cellar." Cassidy and O'Hara argue no more.

THE Baker City (Oregon) Gas and Electric Company, which is controlled by Messrs. Edwin L. Fish, J. H. Parker and J. T. Donnelly, and capitalized in $200,000, has been organized for the purpose of owning and operating gas and electric lighting and power plants in Baker City and elsewhere in the State of Oregon.

THE latest thing in the proposed renewed gas supply for South Amboy, N. J., is to revamp the old Company. Quite a sum will have to be expended on the old plant before it could be put into active commission.

CONTRACTS for the new buildings for the Santa Clara (Cal.) Municipal Gas Works have been let. It is thought and said that the new plant will be in operation by January 1st.

THE Philadelphia *Ledger* of the 9th inst., says: "The stockholders of the Lancaster (Pa.) Gas Light and Fuel Company and of the Lancaster Edison Electric Light Company, who recently gave an option on their stock to Mr. T. K. Worthington, representing Philadelphia capitalists, have been notified that the trade is off. There are 6,500 shares of stock in each Company, and broker Worthington's clients were to pay $160 per share for the gas stock and $10 per share for the electric light stock, besides assuming the bonded indebtedness of both Companies, amounting to $600,000. The option was closed October 1st, and on October 4th the Gas Company declared a 2 per cent dividend. The deal is off, Mr. Worthington says, because his clients consider that their rights were invaded by the declaring of a dividend by the Gas Company, the intending purchasers claiming they were entitled to all the cash in the treasury."

THE sequel to the above is a suit brought or to be brought by attorney W. U. Hensel, on behalf of the shareholders to oblige broker Worthington to make good his contract. If the court holds that the suit is tenable, the broker will be obliged to name his principals, which uncovering is said to be earnestly desired by the management of the Lancaster Gas Light Company. The whole affair cannot redound greatly to the credit of those concerned on either side of it.

THE Salem (Mass.) Gas Light Company will extend its mains to the outlying district of Peabody.

A CORRESPONDENT in Springfield, Ohio, forwards the following: "The first week in this month an ordinance was introduced in the local council which had for its object the fixing of the price that may be charged for illuminating gas in this city. The ordinance calls for a contract for the period of 10 years and provides that the price cannot exceed $1.25 per 1,000 cubic feet; also that an additional charge of 10 cents per 1,000 cubic feet can be made if bills are not paid by the 10th of each month; that no charge shall be made for gas furnished of less than 16-candle power; that no charge shall be made for connecting meter and no charge for meter rental; that companies must lay line pipe to inside of cellar and connect same. It was referred to the Committee on Light and Corporations."

THE *Scientific American* says that in a communication recently presented to the Société Electrotechnique of Hanover, Prof. Krone has established a comparison between the cost of electric power produced by steam and by gas. He has calculated the expense of a steam engine, with or without condensation, including the interest, etc., and the service. To this he adds the cost of an electric installation for 100-horse power. According to his figures, the cost of a horse power (electric) is $0 026 with a non-condensing engine, and $0.024 with a condensing engine. If a gas engine is used, the cost is found to be $0.020 for the same unit under similar conditions; the saving is thus 16 per cent., based upon the best of the steam engines. The author describes a small electric station installed at Clausthal; it has two gas generators and two gas engines of 70-horse power each, making 140 revolutions per minute; the speed may be increased 15 per cent. when it is desired to charge a battery of accumulators. The gas engine is regulated by varying the quantity of the detonation mixture introduced, the proportion of the mixture remaining always the same. The gas engine runs with great regularity, as may be observed by the fact that when one-half its load is thrown off, the speed does not rise more than 3 per cent. These engines are connected directly to two direct current dynamos of 46 kilowatts each. During one year the amount of combustible, anthracite and coke mixed, which was necessary to produce 1-horse power hour of electric energy averaged about 2.3 pounds.

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AGENTS:

New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, OCTOBER 15, 1900.

The Market for Gas Securities.

There was some trading in city gas shares during the week, and it was mainly done at figures a point or more under the closing marks of last Friday. There were no developments of any moment in connection with the local gas situation, unless positive signs of a good and increasing output of gas may be so considered. To day (Friday) Consolidated opened at 169½ to 170; and by noon some sales at the latter figure had been made. The closing was 169½ to 170. The inquiry for Standard, common and preferred, still continues.

Brooklyn Union is reported at the somewhat stereotyped quotation of 160 to 170. Peoples Gas Light and Coke Company, of Chicago, suffers from the rather queer rate war now on there; but those competent to predict incline to the view that the war will soon terminate. Bay State shows some indication of life, having sold within the week at 1¼! Baltimore Consolidated is nominally 53½ to 53⅝. The inquiry for good gas bonds still keeps up. In our advertising columns will be found a notice of the sale at auction of the Cooperstown (N. Y.) gas works, set for Thursday next.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

OCTOBER 15.

☞ All communications will receive particular attention. ☜ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$4,595,200	100	169½	170
Central Union, Bonds, 5's	3,000,000	1,000	106	107½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	120	..
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	298	305
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	..
New Amsterdam Gas Co. Bonds, 5's	11,000,000	1,000	105	105½
Northern Union, Bonds, 5's	1,250,000	1,000	102	103
New York and East River Bonds 1st 5's	3,500,000	1,000	106	106⅝
" 1st Con. 5's	1,500,000	..	115	.
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	132	136
Preferred	5,000,000	100	149	152
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,600	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	160	170
" " Bonds (5's)	15 000,000	1,000	115	119
Bay State	50,000,000	50	1⅛	1¼
" Income Bonds	2,000,000	1,000		75
Binghamton Gas Works	450,000	100	25	28
" 1st Mtg. 5's	475,000	1,000	90½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	..	4½
" " Bonds, 5's	5,250,000	1,000	63	65
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¾
Cincinnati G. & C. Co.	8,500,000	100	199½	201
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	105
Consumers, Toronto	1,700,000	50	230	235
Consolidated, Baltimore	11,000,000	100	58¾	59¾
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12	16
" Con. Mtg. 5's	380,000	1,000	80	85
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95	97
" Prior Lien 5's	4,598,000	1,000	99¼	100
Detroit Gas Co., 5's	396,000	1,000	100	101
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	105	107
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	280
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	72	82
" Bonds, 6's	2 650,000	..	98	100
Jackson Gas Co.	250,000	50	70	75
" 1st Mtg. 5's	250,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101¼	103
Laclede, St. Louis	7,500,000	100	68½	69
Preferred	2,500,000	100	95	100
Bonds	10,000,000	1,000	107	107½
Lafayette Gas Co., Ind.	1,000,000	100	35	40
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co.	400,000	100	68	75
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	87¼	87¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	90¾	91
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¼	47½
St. Paul Gas Light Co.	1,500,000	100	48	52
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90½
St. Joseph Gas Co.	1,000,000	100	30	35
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	..	11
Bonds	1,612 000	1,000	88½	93
Washington, D. C	2,000,000	20	266	267
First mortgage 6's	600,000	..	.	..
Western, Milwaukee	4,000,000	100	90	91
Bonds, 5's	3,830,500	.	107	107½
Wilmington, Del.	600,000	50	200	201

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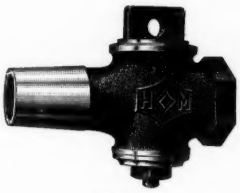

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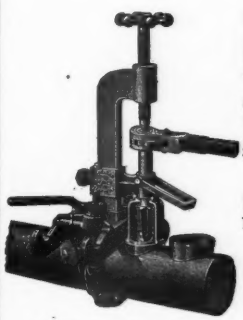

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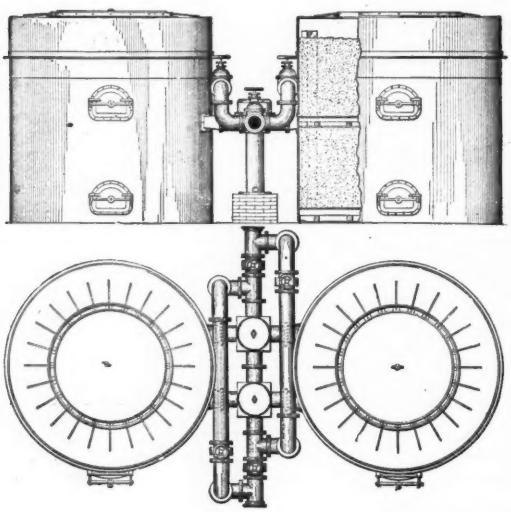

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Halifax, England	1,000,000
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Ottawa (Second Contract)	250,000
Brantford (Remodeled)	200,000
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Kingston, Pa.	125,000
Montreal	500,000
Peterborough, Ont.	250,000
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St. Catherine's (Second Contract)	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000

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York, England	750,000
Rochester, England	500,000
Kingston, Ont.	300,000
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Caterham, England	150,000
Enschede, Holland	150,000
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Burnley, England	1,500,000
Kingston-on-Thames, England	1,750,000
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Tonbridge, England	300,000
Stretford, England	500,000
Oldbury, England	300,000
Saltley Works, Birmingham, England (Third Contract)	2,000,000
York, England (Second Contract)	750,000
Rochester, England (Second Contract)	500,000
Newport, Monmouth, England	250,000
Todmorden, England	500,000
Tokio, Japan	1,000,000
Nelson, British Columbia (Complete Gas Works).	

Sutherland Construction & Improvement Co.

Offices: 15 WALL ST., NEW YORK, and OSHKOSH, WISCONSIN.

Owners of the "SUTHERLAND" Patents for Water Gas Apparatus.

Gas, Electric Light, Water Works, and Electric Street Railways Built, Remodeled, Operated, Bought and Sold.

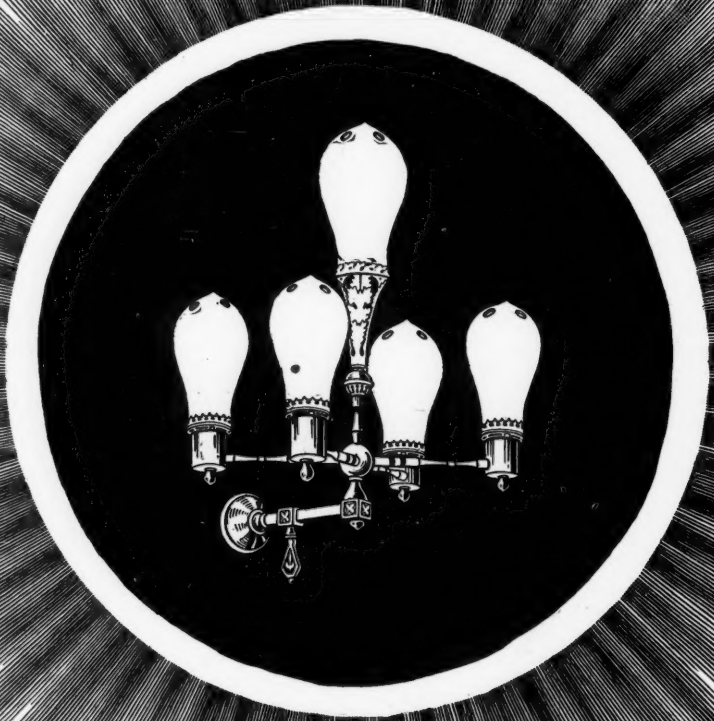
A few of the places where the SUTHERLAND Apparatus is in successful operation:

Ilion, N. Y.
Herkimer, N. Y., 2 orders.
Little Falls, N. Y.
Fishkill-on-Hudson, 2 orders.
Clifton Springs, N.Y., 2 orders.
Green Bay, Wis.
Stevens Point, Wis.
Tarrytown, N.Y., 3 orders.
Ft. Henry, N. Y.
Gainsville, Fla.
Hollidaysburg, Pa.
Waterville, N. Y.
Huntington, L. I.
Lexington, Mo.
Mendota, Ill.
Circleville, O.
Joplin, Mo.
Ashville, N. C.
Youngstown, O.
Kingston & Rondout, N. Y.

CORRESPONDENCE SOLICITED.

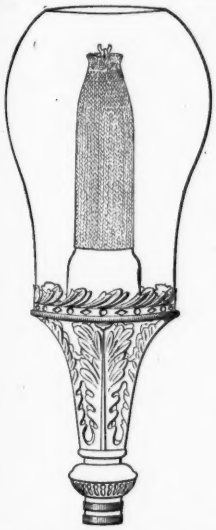
KERN

INCANDESCENT GAS LIGHT CO.



18 MURRAY ST.

NEW YORK.



Kern Incandescent Gas Light Company's Systems.

NO CHIMNEY. NO BREAKING GLASS.
NO BLACKENED MANTLES.

CAN BE USED WITH

Manufactured Gas, Non-Carburetted Gas, Natural Gas or Gasoline Gas.

35 TO 40 CANDLES PER CUBIC FOOT.

Burner No.	o	consumes	8/10	cu. ft.	.	30-candle power.	Burner No.	3	consumes	3	cu. ft. . 105 candle power.
"	"	1	"	1	"	. 35 " "	"	"	4	"	4 " . 140 " "
"	"	2	"	2	"	. 70 " "	"	"	7	"	7 " . 225 " "

Prices Reasonable. Catalogues on Application. Agents Wanted.

KERN INCANDESCENT GAS LIGHT COMPANY,

18 MURRAY STREET, NEW YORK.

Steward Burners.

Closest Attention to **Durability, Candle Power, Finished Appearance.**

Samples to be Had for the Asking.

Write for neat vest pocket memorandum book. Sent Free.

The D. M. Steward Mfg. Co.,

New York Office, 107 CHAMBERS ST. CHATTANOOGA, Tenn.

BRAY BURNERS.

WILLIAM M. CRANE COMPANY,
SOLE AGENTS FOR UNITED STATES,
1131-1133 Broadway, New York.

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Distributing Agents for Pacific Coast,
San Francisco, Cal.

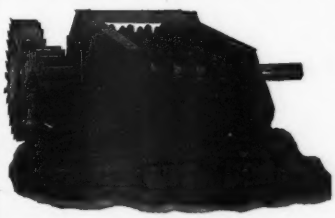
SAFETY GAS MAIN STOPPER CO.

108 EAST 117TH ST., N. Y.

FOR SHUTTING OFF GAS IN MAINS TEMPORARILY DURING ALTERATIONS AND REPAIRS

THE LINK-BELT MACHINERY CO.,

ENGINEERS, FOUNDERS, MACHINISTS,
Chicago, U. S. A.



"Link-Belt" Breaker.

LINK-BELT ELEVATING & CONVEYING MACHINERY for HANDLING COAL, COKE, OXIDE, ETC.

Tilting Coal and Coke Cars,
Breaker Rolls, Shaking Screens,
Power Transmitting Machinery.

Machinery designed and erected to suit existing conditions and available space.

CATALOGUE UPON APPLICATION.

AMERICAN GAS COMPANY

Constructors of Coal Gas Apparatus.

EASTERN AGENTS FOR

BREDEL'S SYSTEM
COAL GAS PLANTS AND GAS APPARATUS.

P. H. & F. M. ROOTS CO.'S
Exhausters, Governors, etc.

GENERAL AGENTS FOR

BRONDER'S CHARGING AND DISCHARGING MACHINES.

AMERICAN GAS COMPANY,

222 South Third Street, Philadelphia, Pa.

FRED. BREDEL, C.E.

Coal and Water Gas Plants.

OWN SYSTEM.

RECUPERATIVE FURNACES, WASHERS, CONDENSERS, PURIFIERS, PURIFYING MACHINES, COKE CONVEYERS, ETC.

SOLE UNITED STATES AGENT FOR
ARROL-FOULIS MECHANICAL CHARGING AND DRAWING MACHINES.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

GAS RETORTS AND SPECIAL BLOCKS AND FIREBRICK MANUFACTURED UNDER THE SUPERINTENDENCE OF MY OWN CHEMIST.

COMPLETE GAS WORKS

No. 118 Farwell Avenue, · Milwaukee, Wis.

Eastern Agents: AMERICAN GAS CO., Construction Department, 222 So. 3d St., Phila., Pa.

ROOTS'

LATEST IMPROVED GAS EXHAUSTER

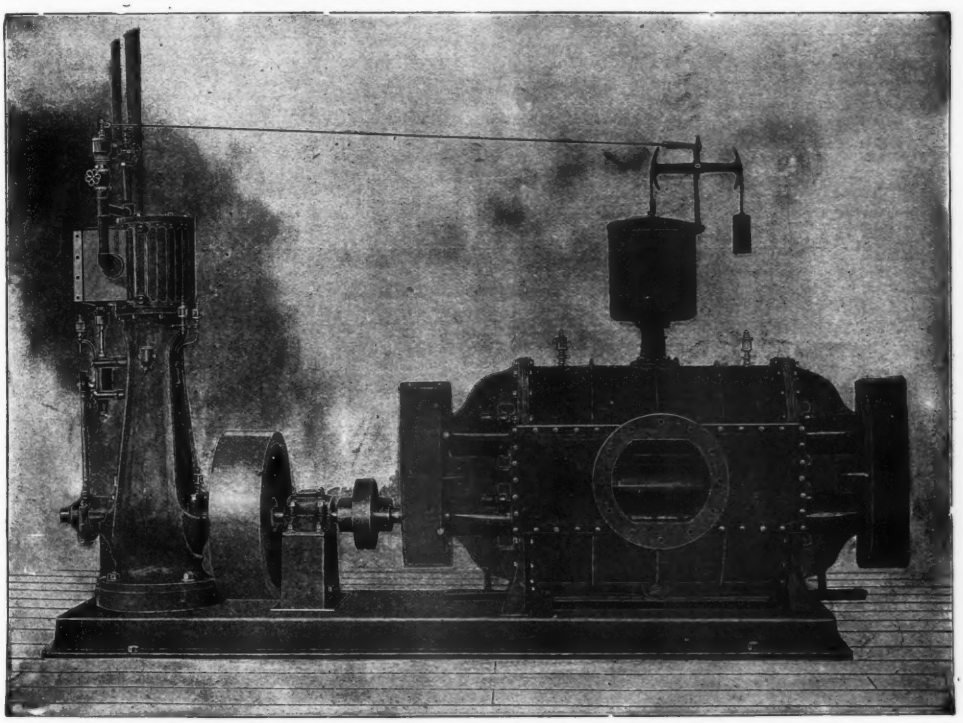
—AND—

NEW GAS GOVERNOR AND STEAM VALVE.

GUARANTEED TO REGULATE WITHIN ONE-TENTH OF AN INCH, WATER PRESSURE.

The Most Perfect Gas Governor on the Market.

MORE DIRECT IN ACTION. FEWER PARTS.
EASIER TO ADJUST THAN ANY OTHER GOVERNOR.



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Connersville, Ind. 109 Liberty St., New York.

Eastern Office:

American Gas Company,

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WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

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CAST IRON WATER AND GAS PIPE,

From Three to Forty-Eight Inches Diameter. Also, all Sizes of

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

"Globe" Specials, Valves, Etc. "Clamorgan" Pipe Fittings

M. J. DRUMMOND & CO.

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GAS and WATER PIPE

GENERAL SALES OFFICE. 192 BROADWAY. NEW YORK.

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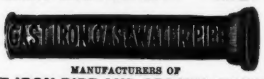
EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAU , PA.



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Also, FLANGE PIPE, LAMP POSTS, Etc.

CHARLES MILLER & SON CO., Selling Agents, Utica, N.Y.

Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, Jute, etc.

Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

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MALLEABLE AND CAST IRON FITTINGS,

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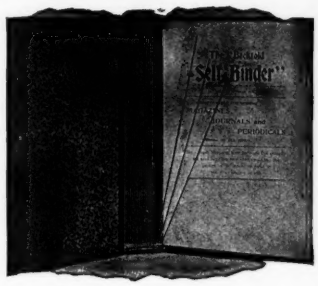

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PROPRIETORS,

THE NOVELTY STEAM BOILER WORKS,

BROOKLYN, N. Y.

STORAGE TANKS FOR GAS WORKS,

To Retain Fluid Material of Any Sort.

PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

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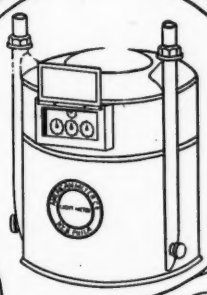
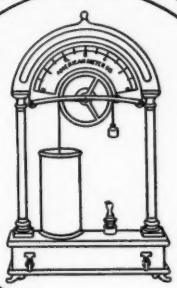
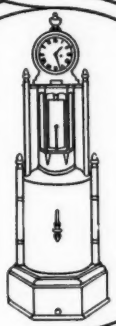
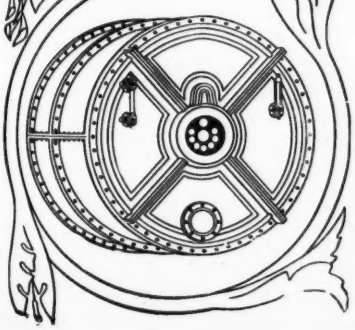
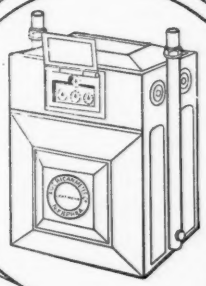
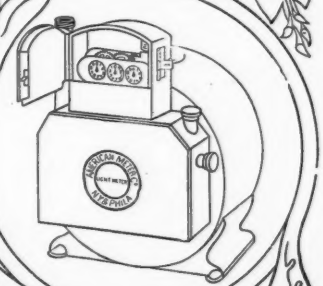












PUBLIC LIGHTING TABLE.

NOVEMBER, 1900.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Thu.	1	12.10 AM	5.30 AM	4.45	5.35
Fri.	2	1.30	5.30	4.45	5.35
Sat.	3	2.40	5.30	4.45	5.35
Sun.	4	3.50	5.30	4.45	5.35
Mon.	5	No L.	No L.	4.40	5.45
Tue.	6	No L. FM	No L.	4.40	5.45
Wed.	7	No L.	No L.	4.40	5.45
Thu.	8	5.20 PM	7.20 PM	4.40	5.45
Fri.	9	5.20	8.20	4.40	5.45
Sat.	10	5.20	9.20	4.40	5.45
Sun.	11	5.10	10.30	4.40	5.45
Mon.	12	5.10	11.30	4.30	6.00
Tue.	13	5.10 LQ	12.30 AM	4.30	6.00
Wed.	14	5.10	1.30	4.30	6.00
Thu.	15	5.10	2.20	4.30	6.00
Fri.	16	5.10	3.20	4.30	6.00
Sat.	17	5.10	4.20	4.30	6.00
Sun.	18	5.10	5.50	4.30	6.00
Mon.	19	5.10	5.50	4.25	6.00
Tue.	20	5.10	5.50	4.25	6.00
Wed.	21	5.10 NM	5.50	4.25	6.00
Thu.	22	5.10	5.50	4.25	6.00
Fri.	23	5.10	5.50	4.25	6.00
Sat.	24	5.10	5.50	4.25	6.00
Sun.	25	5.10	6.00	4.25	6.00
Mon.	26	7.50	6.00	4.20	6.10
Tue.	27	9.00	6.00	4.20	6.10
Wed.	28	10.00	6.00	4.20	6.10
Thu.	29	11.10 FQ	6.00	4.20	6.10
Fri.	30	12 20 AM	6.00	4.20	6.10

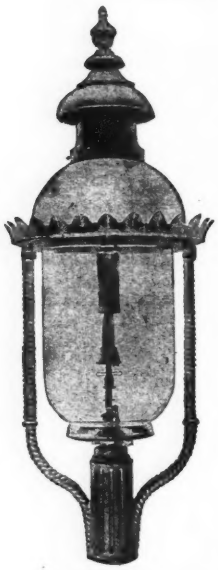
TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr	2221.40	Total, yr	3987.45

NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 54 Lake St.

Welsbach Street Lighting Company

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in seventy-five Cities and Towns.

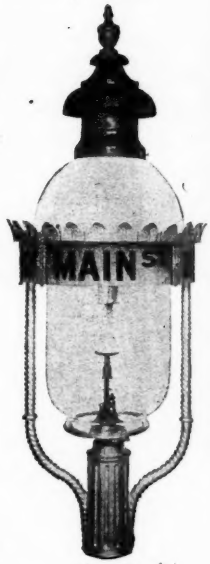
By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.



No. 38.

Correspondence solicited from Gas Companies and others interested in Municipal and outside lighting.

Welsbach Famous Mantles.

THE INCOMPARABLE

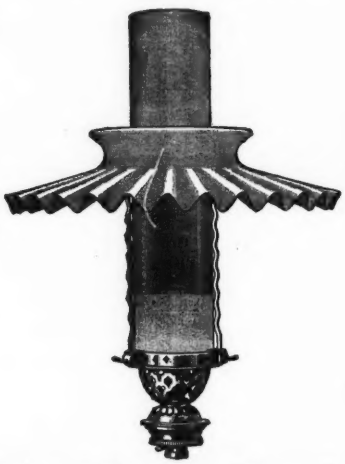
"Yusea" Welsbach Mantle

FINEST EXAMPLE

OF INCANDESCENT

GAS LIGHT

EVER EXHIBITED.



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WELSBACH BRANDS

—OF—

Magnificent Brilliancy

—AND—

Endurance.

THE HIGHEST ILLUMINATION,

The Lowest Cost.

Welsbach Lamps, Mantles, and Complete Line of Glassware and Supplies

WELSBACH COMPANY,

GLOUCESTER, N. J.

Chicago Branch Department and Supply House, - - - - - 70 Wabash Avenue.

THE UNITED GAS IMPROVEMENT COMPANY.

THE STANDARD DOUBLE SUPERHEATER LOWE WATER GAS APPARATUS.

CONTRACTS RECEIVED SINCE JANUARY 1, 1900.

	SETS.		SETS
DANSVILLE, N. Y.	1	HACKENSACK, N. J.	1
WEST CHESTER, PA.	1	TIFFIN, O.	1
COHOES, N. Y.	2	MOUNT HOLLY, N. J.	1
OGDEN GAS CO., CHICAGO	1	SEATTLE, WASH.	1
CENTRAL UNION GAS CO., NEW YORK	1	TARRYTOWN, N. Y.	1
SPENCER, MASS.	1	HOBOKEN, N. J.	2
SAN FRANCISCO	1	PATERSON, N. J.	2
BROOKLYN UNION GAS CO., BROOKLYN	1	NEWARK, N. J.	2
RICHMOND, VA.	2	JERSEY CITY, N. J.	1
CAMBRIDGE, MASS.	2	AUSTIN, TEX.	1
CARBONDALE, PA.	1		

NUMBER OF SETS 27
TOTAL SETS INSTALLED TO JANUARY 1, 1900 327

TOTAL SETS INSTALLED TO DATE 354
TOTAL DAILY CAPACITY . . . . . 226,600,000 Cubic Feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY Prest. DAVID R. DALY V. Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

E. D. WHITE, President. A. H. GUTKES, Vice-President. H. A. PERKINS, Secretary.

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.

Office, 88 Van Dyke St. Brooklyn, N. Y.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office:
914, 915 & 916 Wainwright Building, St. Louis, Mo.

The Construction of Gas Works

PRACTICALLY DESCRIBED,

By WALTER RALPH HERRING.

Price $2. For Sale by

A. M. CALLENDER & CO.,

32 Pine Street, N. Y. City.

Adam Weber,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

Works,
LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR., CO.,

Hamilton Building, Fifth Avenue,
PITTSBURGH, PA. P. O. Box 373.

Successor to WILLIAM GARDNER & SON,

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1850.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE

RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT BALTIMORE MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12 x 12 x 2 and 16 x 16 x 2.

WALDO BROS., 102 MILK ST., BOSTON, MASS.

Sole Agents for New England States.

JOHN DELL,
General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

— MANUFACTURERS OF —

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are prepared to furnish and erect COMPLETE, Half and Full Depth Benches of 6's, 8's, 9's, with Regenerative Furnaces, Constructed to Burn either Coal or Coke. Also Plain Benches.

CORRESPONDENCE IS RESPECTFULLY SOLICITED.

{ CITY OFFICE: 411 Olive St., Continental Bank, } ST. LOUIS, MO.

National Gas and Water Company.

CONTRACTORS FOR
Gas Plant Machinery

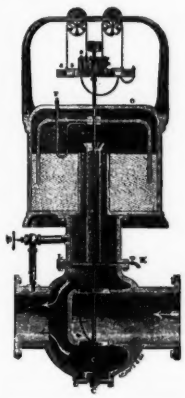
SOFT COAL OR COKE
WATER GAS GENERATORS
A SPECIALTY.

218 LA SALLE ST.,
CHICAGO.

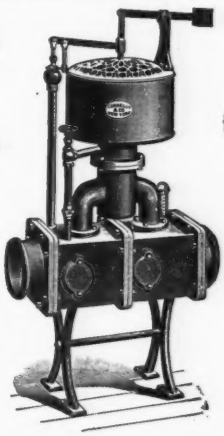
Gas Engineers
INSPECTION AND ADVICE.

PLANS AND ESTIMATES
FOR IMPROVEMENTS OR
REPAIRS.

GAS WORKS SPECIALTIES,



AUTOMATIC STREET GAS GOVERNORS,
BALANCE GAS GOVERNORS.
"Iron Sponge" and Natural Oxide
FOR GAS PURIFICATION.
EXHAUSTERS, ETC.



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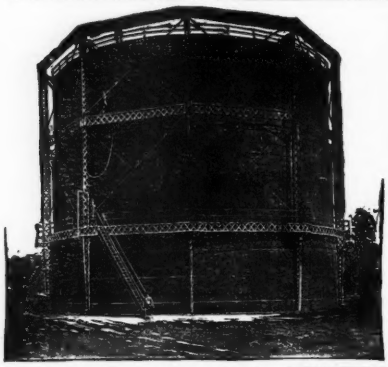

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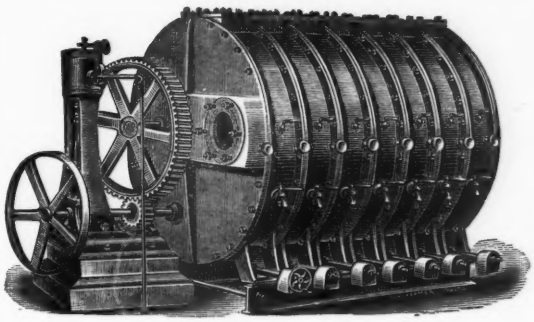

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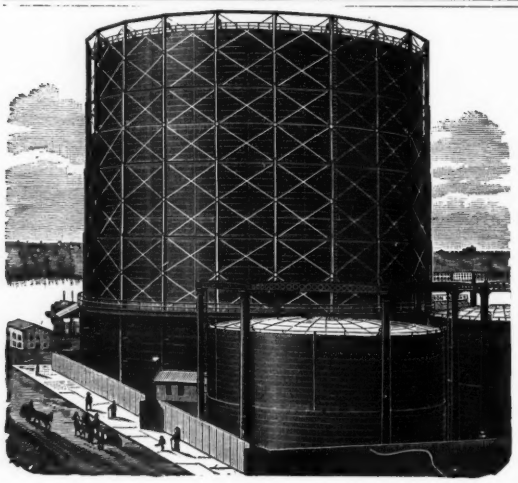

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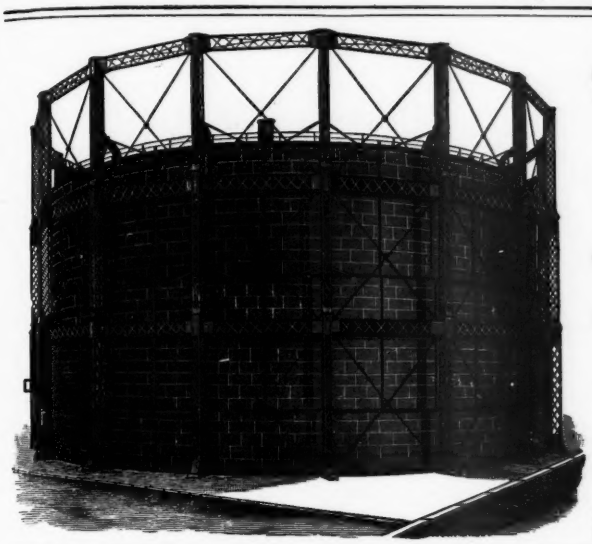

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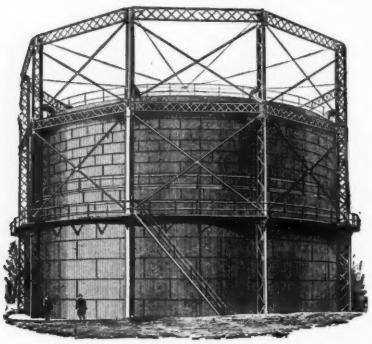

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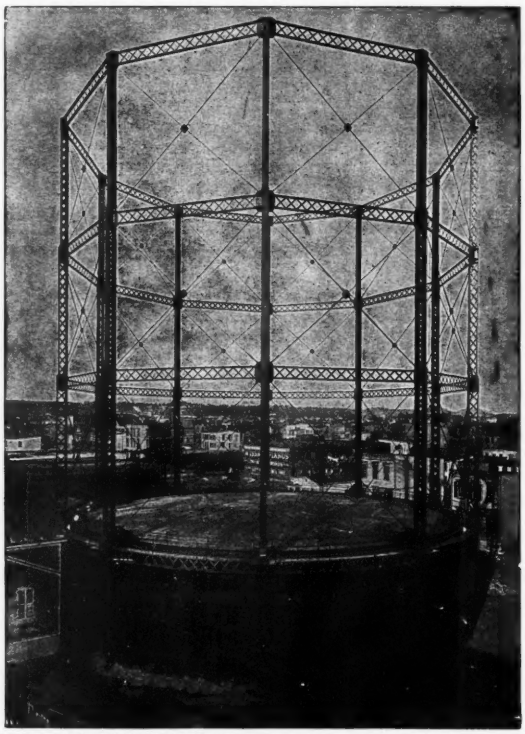

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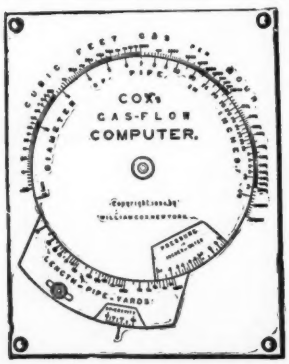

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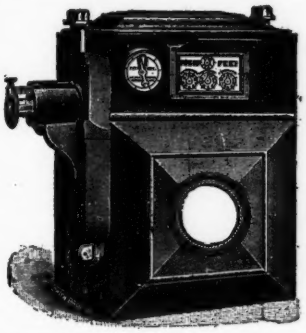

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